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THE
JOURNAL OF TUBERCULOSIS

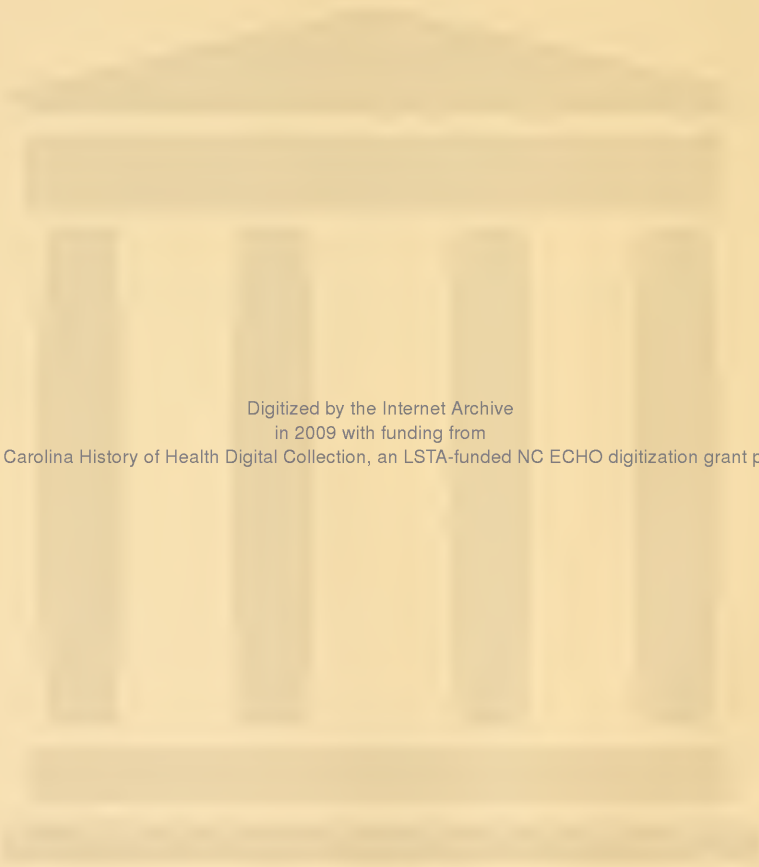
A Quarterly Magazine Devoted to the Prevention and Treatment
of Tuberculosis

EDITED BY
KARL VON RUCK AND SILVIO VON RUCK
Asheville, N. C.

VOLUME FIFTH, 1903

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ORIGINAL COMMUNICATIONS.

ON THE RELATIONS BETWEEN HUMAN AND BOVINE TUBERCULOSIS.*

BY PROFESSOR P. VON BAUMGARTEN, TÜBINGEN, GERMANY.

When, after the discovery of the tubercle bacillus it was shown that the same bacillus was found in human and in bovine tubercle and when further it was demonstrated that bacilli from these respective sources, through experimental inoculation, caused identical lesions in small animals, there was little doubt as to the identity of the germs in question. Additional confirmation of this view appeared later, more particularly as a result of the investigations in my laboratory of Troje and Tangl who experimented with human tubercle bacilli which had been reduced in virulency by treatment with iodoform. These experiments showed that by inoculation of rabbits with such bacilli a tuberculosis closely resembling pearl disease could be produced. The preparations which were at that time demonstrated before the Berlin Medical Society excited much interest and more especially that of Professor Virchow.

The distinctive characteristics of bovine tuberculosis as compared with human tuberculosis consist therein, that the bovine affection appears to show a predilection for serous membranes while human tubercle seems to have its seat preferably in the parenchyma of organs, and that bovine tubercles are not usually found as small miliary or submiliary nodules, but form nodules of larger size which are pedunculated and are often attached to connective tissue strands upon which they are arranged as are pearls upon a string, a characteristic which led to the designation of pearl disease. To these differences must be added the much greater tendency to calcification of bovine tubercle, a dissimilarity which is, however, not histologic, but is caused by the greater amount of lime salts in the food of cattle.

A comparison of preparations obtained from rabbits, inoculated with human tubercle bacilli which had been diminished in virulence by reason of subjection to the effects of iodoform, with preparations from pearl

* Translated for the *Journal of Tuberculosis* from the author's manuscript.

disease, makes it readily apparent that there is, indeed, a far-reaching similarity between the anatomical products of the two affections, and that for the disease in the rabbit the term of *pearl disease of the rabbit* is perfectly justified.

This weighty evidence for the identity of human and bovine tuberculosis left, nevertheless, a gap, in the fact that proof of successful transmission of human tubercle bacilli to cattle was not sufficiently established. Although efforts have repeatedly been made to prove such transmission and positive results have been claimed, a critical examination of the records of these various experiments and of the material shows that in no instance has such an experiment been successful to a degree that it is free from objections. For this reason as long ago as 1891 I sought to settle this much mooted question through personal experimentation upon calves. Contrary to expectation, I arrived at absolutely negative results! While the infection of the control-calf with bovine tubercle bacilli caused its death at the end of six weeks from acute, general, miliary tuberculosis, the calf which was inoculated with tubercle bacilli from a human source remained perfectly well, although these bacilli showed a rather high degree of virulence for guinea pigs and rabbits. At the point of inoculation only a slight reaction was noted and when the animal was killed six months after inoculation not a trace of tuberculosis could be found either at the point of infection or elsewhere within the body.

The results of my investigations were, therefore, exactly the same as those which have more recently been obtained from the well-known and more extensive experiments of Professors Koch and Schütz, viz., that cattle are not receptive to the human tubercle bacillus.

Even at that time I was in possession of an additional experience which I obtained under peculiarly coinciding circumstances and which supported my animal experiment in a significant manner. As cattle are not susceptible to inoculation with the human bacillus, so is man insusceptible to the bovine bacillus. For many years I looked upon this experience as a wholly insolvable riddle and only the negative result of the experiment, made in my laboratory with virulent human bacilli upon calves, offered a satisfactory explanation. Even then I did not consider it timely to make public these experiences, but the intense interest excited by Prof. Koch's announcement at the Congress in London appeared to render it a duty to publish my observations in regard to the non-communicability of pearl disease to man.

The validity of these bacterio-therapeutic experiments upon man has been objected to on the ground that patients suffering from malig-

nant disease did not furnish a suitable soil for the development of tubercle bacilli, an objection which is, however, without foundation, inasmuch as we now know that carcinoma and tuberculosis are quite frequently associated in the same individual and even in the same organ. Again it has been argued that subcutaneous inoculation was unsuitable, because by this method of inoculation the bacilli were prevented from exerting their virulence. But this objection is likewise inadequate, because in a species of animals which is susceptible to the bovine bacillus, as for example the rabbit, subcutaneous inoculation causes without exception a fatal issue through a generalized tuberculosis. Furthermore numerous instances have been observed in man in which by accidental subcutaneous infection with human tubercle bacilli, actively progressing tuberculosis with lethal termination has been produced. The validity of the evidence, therefore, of the experiments under consideration cannot be questioned, but at the same time I would not estimate them as so highly conclusive as to justify their acceptance as unconditionally negating the question of the communicability of bovine tuberculosis to man.

This question is of so far-reaching import for the public weal and upon its decision depends the maintenance or abandonment of such expensive sanitary measures, that the great attention which has been given the subject by sanitary authorities is easily understood. The degree of importance attached to it is witnessed by the fact that the Imperial Health Bureau in Berlin has inaugurated the control of the experiments of Professors Koch and Schütz upon a large scale. The plan of these experiments was formulated last spring with the coöperation of many tuberculosis experts, and they are now in full progress. In other hygienic and pathologic laboratories investigations of this subject are being diligently carried out. Such experiments for which special appropriations have been made are also in progress in my institute.

The chief object of all these additional experiments will undoubtedly be to determine whether, by the inoculation of calves with human tubercle bacilli from as many different sources as possible, and more particularly from primary tuberculosis of the digestive apparatus, under any circumstances the transmission of human tuberculosis to cattle is possible. Should, perchance, positive results be obtained they would serve as evidence that, in the particular cases of human tuberculosis from which the successful inoculations were made, the tubercle bacilli originally came, without exception, from bovine sources, because there is already a consensus of opinion that, as a rule, human tubercle bacilli are not infectious for the calf and that at most they can produce only a harmless, local

tuberculous affection, whereas bovine tubercle bacilli are without exception, extremely virulent for calves.

In view of the actual importance of this question it is not to be wondered that it has offered the most momentous topic of discussion at the recent session of the International Tuberculosis Conference in Berlin, and it may not be without interest to the readers of this Journal if, in addition to the foregoing, I relate to them from my own recollection the course of the transactions of this meeting in so far as they pertain to this subject. I beg, however, that my version be regarded rather as an improvised communication than a well ordered, scientific report.

This particular session which, as were all others of the Congress, was held in the large hall of the Prussian House of Representatives, was opened with an address by the President of the Imperial Health Bureau, Geheimrath Koehler, in which he reviewed the subject very comprehensively and pointed out the significance of the identity of human and bovine tuberculosis in a most objective manner. While he ended his address with the conclusion that the question was still unsettled, it was, nevertheless, apparent from the whole that the evidence for non-identity was in the preponderance.

A materially different position was taken by the respondent, the well-known French veterinary pathologist, Nocard who argued strongly for the identity of bovine and human tuberculosis and for its practical consequences. While he admitted that the transmission of human tuberculosis to cattle was but rarely successful, he particularly emphasized that such transmission has, nevertheless, been demonstrated in isolated instances and in a manner free from objection; that we must distinguish between different degrees of virulency of human tubercle bacilli for the highly virulent forms of which the calf was receptive, although it was not for the attenuated varieties; also that like degrees of virulence existed in bovine tubercle bacilli as well, and that when we use bovine bacilli for inoculation of calves we occasionally find but very slight local changes. He asserted that calves are much more susceptible to bovine than to human bacilli and that Koch was quite right in concluding that, if in the calf a generalized tuberculosis is induced by inoculation with human tuberculous material, the bacilli in question had in the last instance a bovine origin, i. e., they must have been transmitted from cattle to the human subject. Nocard considers it demonstrated that the tubercle bacilli of pearl disease can produce human tuberculosis and he accepts as evidence for this the cases of local, cutaneous tuberculosis of veterinarians and butchers, and also the cases of primary intestinal tuberculosis

in man which could hardly be explained otherwise than by the use of tuberculous milk. That in such cases, infection of man with bovine tubercle bacilli really took place, he said, was shown by the exquisite, positive inoculation results which Wolff and others had obtained from such material. The strict measures against the acquirement of tuberculosis by man through the use of milk of tuberculous cows should therefore be maintained to their full extent and should be further increased.

Both these communications gave rise to a very lively and, in part, excited discussion.

The first speaker was Professor Arloing of Lyons, a well-known student of tuberculosis and one of the most decided adherents of the theory of identity. While he also accepts a difference in pathogenic activity of human as well as of bovine tubercle bacilli, he does not so in the sense that Koch does, who believes that human tubercle bacilli are not virulent for cattle and that bovine tubercle bacilli are not virulent for man, but in the light that there exists a certain scale of virulence, beginning with the slightly virulent human bacilli and extending upward to more virulent human bacilli or bovine bacilli, to the most virulent bacilli of pearl disease. He looks, therefore, upon the bacilli of pearl disease as the most virulent of the family of bacilli under consideration. In this manner he accounts for the fact that the inoculation of calves with bacilli from bovine tuberculosis never fails, although these bacilli, too, vary gradually and materially in their pathogenic action. But also with certain cultures of human bacilli he was able to produce extensive tuberculous lesions in calves (I will, however, show directly that the positive results claimed by Arloing are by no means conclusive). Arloing, therefore, concludes that human tuberculosis is transmissible to cattle and that likewise, and much more easily, bovine tuberculosis is transmissible to man.

After Arloing, Hueppe addressed the meeting. As rich as was his discourse in personal points he contributed nothing new or important to the subject. He maintained his position as to the identity of the two forms of bacilli and repeated his oft expressed belief in the influence of individual disposition upon the result of inoculation. He regarded the intercommunicability of human and bovine tuberculosis as established, without, however, contributing any evidence of his own in support of such a conclusion. Like Nocard and Arloing he closed by demanding that the existing prophylactic measures against human infection through the use of milk and meat of tuberculous animals be continued with all rigor.

After Hueppe I was called upon to speak. Inasmuch as, with the

exception of Koehler, all the speakers had opposed Koch's new view it was perhaps a change for those present to now hear one in support of Professor Koch. I limited my remarks to a defense of the most important proposition of Koch, that human tuberculosis cannot be experimentally transmitted to calves. I pointed out that all the experiments which have been made up to the present time and which have been intended to prove the error of Koch's proposition could not stand as evidence, because they have all been made in an objectionable manner. I pointed out that, in order to obtain conclusive results for the settlement of this question, inoculations should not be made otherwise than subcutaneously, and that the number of tubercle bacilli introduced must not be too large. Only thus could it be shown whether or not a tuberculous infection takes root at the point of inoculation and extends therefrom within the organism through the chain of lymphatics and the blood stream. Further I called attention to the fact that intravenous injections are entirely useless for this purpose, because even with dead tubercle bacilli a disease similar to tuberculosis may be produced which could result fatally, not because of the existence of actual tuberculosis, but on account of embolism induced by foreign bodies which in the present instance would be tubercle bacilli. Experience having shown that even by intraperitoneal application of dead tubercle bacilli an affection simulating tuberculosis can be engendered upon the peritoneum, which in spite of resemblance is not a true peritoneal tuberculosis no more than it would be if lycopodium or some other foreign substance had been used, it follows that for the settlement of the question under consideration intraperitoneal infection must also be avoided.

Examination of the experiments reported and which have been brought forward as contradictory to Koch's views, shows that the inoculations have been made either intravenously or intraperitoneally. By the intravenous method were made all those reported by Arloing.

In only a few of these experiments has the subcutaneous method been employed, but it has been applied in a manner which is by no means free from objection; in these, emulsions of tubercle bacilli in amounts even of 12 c. c. have been injected into the neck subcutaneously, a procedure which can very readily give rise to an unintentional intravenous injection. I was, therefore, obliged to deny that sufficient evidence had been supplied by all these experiments to controvert Koch's proposition and in conclusion I pointed to the experiments upon calves which have recently been made at my institute in Tübingen with highly virulent

human tubercle bacilli and which again had an exquisitely negative result.

The next speaker was Max Wolff whose name is now often mentioned in connection with this question, because he published an apparently positive result from the inoculation of a calf with human tubercle bacilli. Wolff restated his experiment. For my own part I would like to add that my doubts concerning the evidence of this experiment became the greater as I inspected the preparations which were exhibited and which in part showed very large tuberculous masses, especially in the liver, which awakened the suspicion that these were much older than the experiment. While at the time of the inspection of these preparations which I made the day before the session, I naturally disliked to express to my friend Wolff and the other tuberculosis experts my suspicion as to the value of the evidence of the experiment, the matter nevertheless appears so important that I do not feel justified in withholding my objections. That my criticism is warrantable will be shown immediately.

After Wolff, the veterinary pathologist, Bang of Copenhagen reported upon a number of experiments in which human tubercle bacilli were inoculated into the anterior chamber of the eye of calves. This procedure resulted in the formation of minute nodules upon the iris which Bang regards as actual tuberculosis of the iris. It is my opinion, however, that in these cases also, the effect was probably a pseudotuberculosis due to foreign bodies. Bang urged the most rigorous measures against cattle suffering from udder-tuberculosis.

More attention was attracted by the communication of Orth who produced peritoneal tuberculosis together with tuberculosis of the lymph glands lying within the path of the lymphatics. His inoculations were made intraperitoneally in a calf and in a goat with part of the kidney of a rabbit which had been tuberculized by direct injections of human sputum. I was not able on careful inspection of the preparations which were exhibited to convince myself that they represented a true tuberculosis and I believe that Orth would have obtained the same result had he killed the tubercle bacilli in the kidney before using the latter for infection. If, however, my doubts carry me too far, then Orth has at most produced a local but non-progressive tuberculosis in his experiment upon the calf.

Orth was followed by Moeller known for his discovery of the acid-proof pseudotubercle bacilli which grow as saprophytes upon certain forms of grass and upon manure, and which have created much interest on account of their great resemblance to the true tubercle bacillus. He

reported feeding and inoculation experiments with human tubercle bacilli upon calves, the results of which were entirely negative and supported Koch's views.

After some few remarks by others which added nothing materially new to the subject, Koch spoke for an hour during which signs of great expectation and rapt attention were manifested on the part of his auditors. The newness and unexpectedness of what he said combined with the wonderful equipoise, clearness of diction and strictly logical sequence of his reasoning, rendered his discourse one of his communications which come as a revelation from a superior mind and hold the hearer spellbound to the end. That I do not overestimate the significant value of his address is witnessed by the stormy and seemingly endless applause which at its conclusion greeted the speaker from all sides as also from those who opposed his views.

With Koch's address the most notable event of the conference transpired. I may now be allowed to relate briefly the substance of his statements.

Koch introduced his remarks by saying that he would discuss only the communicability of bovine tuberculosis to man from the standpoint of practical medicine as applied to the human subject. The infection of man with bovine tuberculosis could, in the main, be caused only by the use of milk and meat as foods. If this mode of infection were a frequent one, then primary tuberculosis of the intestine would be a frequent occurrence in man. Furthermore, since tuberculous meat and more particularly milk containing tubercle bacilli, are used continuously by a great number of people we would naturally expect to observe the occurrence of intestinal tuberculosis in groups and masses just as we actually see endemics of typhoid fever, anthrax, sausage poisoning, etc. Now, inquires Koch, are we acquainted with instances in which such endemics from the use of tuberculous meat and milk have been observed? Only two such observations are mentioned in the literature. The first one of these is that of Ollivier who reported that in a Swiss boarding school in which the milk of a cow suffering with tuberculosis of the udder was used, almost all of the pupils became ill of tuberculosis and died shortly thereafter. This observation has generally been regarded as an absolute evidence of the communicability of bovine tuberculosis to man. It has, however, been overlooked that Ollivier was obliged, at the next session of the Academy, to correct his communication, because in the meanwhile it was shown that the very pupils who became tuberculous had never drunk of the milk of the diseased cow, whereas the teachers of the school who

had constantly drunk the milk of this cow had remained well. This observation, therefore, proves rather the contrary of that which it was intended to prove. The second observation which has been much cited in this connection, is that of Hüls, according to whom the whole family of a miller died in consequence of the use of milk of a cow affected with pearl disease. The members of this family did not die, however, at the same time or at short intervals one after another. On the contrary there were always periods of years between the respective deaths, a fact which renders it very doubtful that the tuberculosis in this family could be referred to the drinking of milk which had been used by all at the same time.

Neither is the evidence more convincing in regard to sporadic cases of human tuberculosis which have been attributed to the use of tuberculous milk. Here we must naturally consider, in the first place, cases of primary intestinal tuberculosis. It is well known that such cases are quite rare, which in itself speaks against the mode of infection under consideration; again the few authenticated cases of primary, human intestinal tuberculosis do not warrant its acceptance. Koch illustrated this point by a striking example. Although all university clinics and anatomical institutes in Prussia have been officially required, since the session of the London Congress, to report all cases of primary tuberculosis of the intestine, only one single case has thus far been reported and this is the same case that Max Wolff has used for his positive inoculation experiment which has since been accepted, almost universally, as an absolutely certain proof of the infectiousness of tuberculous milk for man. In this case Koch obtained a diametrically opposite result from Wolff, i. e., with the use of the same material the calves infected by Koch failed to become tuberculous.

In connection with this statement which caused a general sensation in the assembly Koch said that the truth of the old saying, *Si duo facient idem non est idem*, had never before so clearly been recognized by him as in this instance. My own doubts as to the value of the evidence of Wolff's experiment had thereby received an important support. After further analysis of the cases of primary, human intestinal tuberculosis, additionally recorded in the literature and employed as evidence of the communicability of bovine tuberculosis to man, Koch arrived at the conclusion that there is not a single case in existence in which the injurious influence of tuberculous milk upon man has been demonstrated in a manner free from objection.

In regard to the communicability of bovine tuberculosis to man

through injuries of the skin, Koch admitted that in this way an occasional localized tuberculosis may occur. He denied, however, that such a tuberculosis could assume a progressive course, leading to tuberculosis of internal organs, and said that under all circumstances not a single case had occurred up to the present time in which a generalized tuberculosis was proven to have resulted from inoculation of material from pearl disease.

The experiments made in Königsberg which I have published and which consisted in the inoculation of about a dozen human subjects with highly virulent bovine tubercle bacilli, Koch regarded as an absolutely incontrovertible proof of the non-communicability of bovine tuberculosis to man, and all in all better statistical and clinical observations than are yet recorded in the literature would need to be set opposite this negative experimental evidence, if an unobjectionable claim is to be made for the proof that in a given case human tuberculosis has been produced by infection with the bacilli of pearl disease. Moreover, asserted Koch, it will also be necessary to observe and report all those cases in which the ingestion of food products of tuberculous animals was not followed by infection. In regard to the prophylactic measures against human tuberculosis Koch reiterated the statement expressed by him at the London Congress, that he does not deem it essential to enforce measures against the danger of infection from tuberculous cattle, which is not proved.

If we required only that instead of raw, only boiled milk should be allowed for consumption, this measure alone would cost millions. The chief danger for man being man himself, the consumptive, a successful prophylaxis against human tuberculosis must seek by all manner of means to prevent the infection of the healthy by those who are diseased.

From my own scientific standpoint I am in a position to share Koch's views in all respects. More particularly am I convinced that the tuberculous human subject is the principal, if not, indeed, the sole source for the infection of others. Only in respect to the mode of infection do I differ in part from Koch who believes that the disease is communicated practically only through the sputum. I am of the firm scientific conviction that in this respect Koch goes too far and it is my opinion that if we examined the inhalation theory as critically as Koch has the theory of ingestion from bovine sources, but few cases would be found which would unobjectionably confirm it. The available clinical and statistical evidences for the contraction of tuberculosis by inhalation probably amount to something, but they do not represent much more than do those which are brought forward for the theory of ingestion tuberculosis. The great rôle which Koch attributes to inhalation of tubercle bacilli as the

almost exclusive cause of human tuberculosis I, therefore, consider as unproven. Although I would not deny that inhalation tuberculosis occurs with more or less frequency the majority of cases of tuberculosis appears to me, now as formerly, to be due to inheritance, be this, as is more generally accepted, an inherited or inheritable anomaly of constitution which materially favors infection by the bacillus or be it, as a small minority agrees with me, a direct transmission of the bacillus in the act of procreation or during foetal development from the parents to the child. Propagation of the disease through inheritance would of course be much more difficult of prevention than the spread of tuberculosis through infection by tuberculous sputum but, nevertheless, we should not close our eyes entirely to the degree of danger which menaces the human race from hereditary transmission.

THE CINNAMIC ACID (HETOL) TREATMENT OF TUBERCULOSIS.*

BY PROF. A. LANDERER, STUTTGART.

The cinnamic acid (hetol) treatment of tuberculosis may now look back upon a history of twenty years since its beginning. We shall not enter into the first complicated and not very practical methods of its application, but discuss how it is now applied and consider its value at the present time.¹

The essence of the method consists in the administration of cinnamate of soda (hetol), an indifferent substance, even when given in large doses to non-tuberculous individuals. It is entirely harmless to the kidneys and blood in the dose in which it is employed. Hetol belongs to a group of substances which therapeutically have not as yet been much studied, to the so-called positive chemotactic substances, that is, it possesses the property of attracting leucocytes, especially the multinuclear form, from their place of origin (bone-marrow, spleen, etc.) to the blood in large numbers.

Four to five hours after an intravenous injection of hetol the number of leucocytes in the blood is increased two to five times. After twenty-four hours the number returns approximately to the normal. This observation is of great importance. Metchnikoff's theory that the leucocytes absorb and digest bacteria—phagocytosis—receives at the present time but qualified acceptance. On the other hand it has been proven beyond any doubt that the active substances of the serum, for instance of diphtheria serum, originate in the leucocytes. The increase of leucocytes through the hetol treatment is without question of great importance. Bulloch has shown that hetol increases the so-called immunizing substances (alexines of Buchner) which are of great significance in the fight against infectious diseases.

A noteworthy fact is the difference in action of hetol upon healthy and upon tuberculous individuals. A normal organism can tolerate a dose of 0.1 g. and more when intravenously injected, without any appreciable changes. Tuberculous patients, especially those in advanced

*Translated for the *Journal of Tuberculosis* from the author's manuscript.

¹ A detailed description of the hetol treatment with the clinical history of 241 cases, numerous microphotographs, curves, etc., may be found in *Treatment of Tuberculosis by means of Cinnamic Acid*, A. Landerer, Leipzig, F. C. W. Vogel, 1898.

stages, react to a dose of 10 mg., sometimes even to 5 mg., with a rise of temperature of 1° to 2°C.

Investigations which have not yet been published prove that hetol is able to neutralize a certain quantity of the tuberculous poison in the body. The effects of hetol on tuberculous tissues have been demonstrated on human beings as well as on animals. The caseous, tuberculous foci are surrounded by a ring of white, principally multinuclear blood corpuscles; this wall is converted into a fibrous capsule which separates the tuberculous focus from the neighboring tissue. From this capsule blood vessels and fibrous tissue spread towards the focus; the necrotic caseous masses are absorbed and the bacilli disappear. Finally a radiated cicatrix takes the place of the tuberculous caseous area. In this way the most ideal form of a cure of tuberculous processes is effected, viz., their transformation into dense fibrous cicatrices by means of the hetol treatment, whereas other changes of the tubercle, for instance calcification, can only be looked upon as an incomplete cure.

These histological results of the hetol treatment have been first demonstrated in animals by P. F. Richter.¹ They have been confirmed by Kanzel² and Jurjew;³ and Ewald⁴ has demonstrated the cicatrization and cure of tuberculous foci on the cadaver in the post mortem room. Similar results have been shown by Morkowitin⁵, but Cordes⁶ has brought forward the most convincing proofs. During the hetol treatment of patients suffering from laryngeal tuberculosis he removed small pieces from the larynx in the various stages of the treatment and examined them microscopically. He was able to accurately determine the stages of the action of hetol as mentioned above, viz, the circumvallation of the foci with white blood corpuscles, the fibrous encapsulation, the penetration of the focus by fibrous tissue and blood vessels and finally its transformation into a radiated, not very vascular cicatrix. Thus the experimental, pathological and anatomical proof of the action of hetol on tuberculous processes has been established in a most positive manner, notwithstanding some statements to the contrary.

In reference to the mode of administration of hetol⁷ the following is to be said:

¹ Virchow's *Archiv*, 1893, CXXXIII.

² Inaug. Dissertation, Petersburg, 1895.

³ Inaug. Dissertation, Petersburg, 1899.

⁴ *Berliner klin. Wochenschrift*, 1900, No. 21.

⁵ *Djetsk med.*, 1900, No. 1.

⁶ H. Guttman, Bericht über die in Prof. H. Krause's Poliklinik Behandelten Fälle von Lungen- und Kehlkopftuberkulose, *Berliner klin. Wochenschrift*, 1901, No. 27.

⁷ A short accurate description of the technique is to be found in *Berliner Klinik*, March, 1901.

The indisputably most effective method of administration is the injection of aqueous solutions of hetol directly into a vein. The intravenous method which I have advocated for the last twenty years is not nearly so difficult as is represented by some writers and the opposition to intravenous medication is growing less from year to year.

I inject only into the veins at the elbow. Just as in venesection, an elastic bandage is applied to the upper arm, not too tightly; a syringe which can be sterilized by boiling, with a finely pointed canula, is inserted into the vein at as small an angle as possible, after previously having cleaned the region with cotton dipped in ether. The fluid passes directly out into the circulation when intravenously injected, without causing any swelling, as is the case in the subcutaneous method.

The intravenous injection of hetol produces the characteristic alteration in the blood in the most pronounced manner. Whoever has practically tested both the intravenous and intramuscular methods of injection, must certainly be convinced that the intravenous method is much more effective and yields results where the intramuscular fails (H. Krause). The intramuscular injection is made in children in the gluteal region, in adults into the muscles of the upper arm (Katzenstein¹) or into the upper part of the back. It is not very painful, whereas the subcutaneous injection is. Given internally hetol has practically no effect. The injections are made three times weekly, commencing with a small dose of one-half to one milligram. One division of a syringe holding one cubic centimeter of a one per cent. solution is equal to one milligram. Hetol used for intravenous injections must be chemically pure and the solution perfectly free from bacteria. To these conditions conform the sterilized one per cent., two per cent., and five per cent. hetol solutions, enclosed in tubes, of the firm of Kalle and Co., Biebrich on the Rhein. Gradually the dose is increased by one-half to one milligram until the most suitable dose for the individual case has been reached. The finding of the correct dose is the only difficult part of the hetol treatment. Each case, has, so to speak, its own maximum dose. The same conditions do not prevail in the treatment of tuberculosis by hetol as in the mercurial treatment of syphilis, with which the hetol treatment has at times been compared. Here one can adopt routine measures, because the clinical material, in respect to age, strength and pathological changes is nearly uniform, but in tuberculosis this is not so. What a great difference exists between a powerful man with an incipient affection of the apex

¹ *Muench. med. Wochenschrift*, 1902. No. 33.

and a patient suffering with fever and extensive destructive lesions!

The great diversity of the cases demands a difference in the doses. The selection of the correct dose and the manner in which we may arrive thereat will be best shown by individual cases.

For the solution of this practical question the tuberculous patients—we shall only treat in the first instance of pulmonary tuberculosis—must be divided into certain groups. The first group comprises cases with moderate alterations in the lungs, without fever and without any destructive lesions, cases which I have designated as uncomplicated cases. The best results with hetol are obtained in this group.

The hetol treatment in these cases is comparatively simple. The dose is increased in the course of four to six weeks to ten, twelve or fourteen milligrams; in women, especially those who are nervous, the maximum dose is sometimes reached with five milligrams; strong men without fever can easily tolerate twelve to fourteen milligrams; the maximal dose for children, according to age, is less, one to three milligrams when administered intravenously. The dose of an intramuscular injection can be one and half times larger than that of an intravenous injection. The correctness of the dose may be recognized from the fact that no rise in the temperature occurs and that the patient feels no ill effect. In case the dose is too large, a slight elevation in the temperature takes place, or the patient feels uncomfortable, complains of pressure in the head, of restlessness, loss of appetite, etc., symptoms which soon disappear, if thereafter the correct smaller dose is chosen. This dose is given for a period of six weeks. In mild cases the treatment can be terminated within three months, but a further course of treatment of four to six weeks is to be recommended, after an intermission of from four to eight weeks, even if no symptoms have meanwhile appeared. During the treatment the patient must pursue a proper mode of life. Under a normal course the auscultatory phenomena in the lungs gradually disappear. The dullness generally persists (cicatrization); only in very mild cases does it disappear. In the course of years after the treatment it is possible that the dullness may not be recognizable owing to the development of vicarious emphysema. The expectoration decreases or disappears entirely as well as the tubercle bacilli in the sputum. The body weight increases, often perceptibly only after completion of the treatment. The patients feel in perfect health.

I have under observation such cases which have been cured (and not only mild ones) for a period of twelve years. A large number of physicians agree with me that these cases can be cured permanently. In

uncomplicated cases some physicians have effected cures up to 100 per cent. At any rate cures can be estimated at about 90 per cent. Weissmann, who for the last six years has treated a large number of cases of various forms of tuberculosis with hetol, is of the opinion that by a thorough instruction of the general practitioner in the hetol treatment, in connection with an early diagnosis, if necessary by the tuberculin test, every other method of treatment of tuberculosis becomes unnecessary. He believes that public sanatoria for the poor, results of which in Germany leave much to be desired, will become superfluous and that sufficiently informed general practitioners will be able to cope successfully with the disease.¹

In the more advanced cases, the weaker the patient the smaller should be the dose, increase thereof to be much more gradual. The maximum dose may be 5 mg.; later on the patient may possibly tolerate 7 to 8 mg. It appears, however, more rational to administer small doses over a longer period than to employ larger ones. A positive indication that the dose is too large is a temperature rise of one-half to one degree C. on the evening of the day of the injection, above the regular temperature course on those days when no injection is made. It is advisable that physicians who have not had any experience in the hetol treatment should refrain at first from treating advanced cases and should treat only incipient cases, until they have acquired the necessary experience.

In the more advanced cases the percentage of patients who are cured is naturally smaller. Should destructive lesions (cavities) exist, then the extent of the lesions is of consequence. Smaller cavities (showing percussion dullness and metallic râles) can be caused to heal out in the course of six to eight months. Larger cavities (giving tympanitic resonance and a change of percussion note with metallic râles) become at the best encapsulated and "dry", that is, they secrete but slightly, and even the tubercle bacilli may disappear in the sputum.

The question of fever is a very important point in the treatment with hetol. My experience has led me, in tuberculous patients, to distinguish two types of fever, tuberculous and septic fever. Tuberculous fever shows only slight elevation, about 38.5 °C in the evening. This tuberculous fever disappears gradually by treatment with hetol in the course of one to four weeks. This fact has been observed by Azmanova, Humbert and others. The other type, septic or hectic fever,

¹ *Aerztliche Rundschau*, 1902, No. 40.

shows the well known sharp evening elevations. It is caused, according to the investigations of R. Koch and his school, by mixed infection. The treatment with hetol does not in the least influence a mixed infection. Treatment of a mixed infection was until recently not very hopeful. Some of these cases may gradually recover, if the patient inhales pure air, free from bacilli, for instance in a sanatorium, just as suppuration at times ceases under aseptic dressings. This, according to my views, in addition to proper nourishment, represents the principal value of sanatorium treatment. Nevertheless a large number of mixed infections are not benefitted by treatment in the open air, and it is particularly mixed infection which has such an unfavorable influence on tuberculous patients in the later stages. It is therefore an important problem for the physician when, in the later stages, mixed infection controls the clinical course, to convert, if possible, these cases into purely uncomplicated ones. During the last six months I have succeeded in developing a method, which in a number of cases abolishes the mixed infection without any climatic treatment. I refer to the intravenous injection of colloid silver solutions. I employ argentum colloidal or collargol of Credé. It is only slightly soluble in water; so that one does not really inject a solution into the circulation, but only a mixture; therefore one must not be surprised if rigors follow such intravenous injections which, however, pass over without doing any harm. I therefore looked for another preparation and have found it in lysargin, which contains 52% of silver in a colloid state, has been prepared by Prof. Paal in Erlangen, and is supplied by Kalle & Co., Biebrich. This colloid silver is soluble in water and the solution can be filtered. A 1% aqueous solution is employed.

I have first recognized the value of colloid silver salts in cases of surgical sepsis. When given subcutaneously and when rubbed as an ointment into the skin, they have been, according to my experience, of not much value. In septico-pyæmic processes following variously complicated fractures, in acute sepsis, as for instance acute peritonitis, intravenous silver injections also fail. In subacute cases, however, in which a pyæmic character predominates I have without doubt observed improvement, leading to an eventual cure, follow these intravenous injections. Such cases have also been published by others, for instance by Klotz. The idea occurred to me to try the intravenous injection of silver salts in cases of tuberculosis with septic fever. It is possible, indeed, to remove mixed infections of a moderate degree. The technique is the same as mentioned above for the intravenous method. Whereas

in a case of sepsis 7 to 9 centigrammes, i. e., 7 to 9 c. c. of a 1% solution, are daily administered, until the fever has permanently subsided, in tuberculous patients with septic fever I have started with 4 cgm. (in the evening) and continued with 2 cgm. It is perhaps possible in these cases also to use larger doses, but I have as yet not tried it. No portion of the salt solution should enter the subcutaneous tissues; otherwise painful swellings of long duration are formed. The elastic bandage is therefore removed as soon as the needle is inserted into the vein, and the injection is then made without constriction.

Up to the present time I have accomplished lasting subsidence of such fever only in cases with an evening temperature not exceeding 39° C. In cases with an evening temperature of 40° C. I have seen only a temporary influence upon the temperature. If the mixed infection is cured then hetol is effective. Thus the sphere of the hetol treatment becomes more extensive. A desirable incidental effect of the injection of the silver salts is a material decrease of the expectoration.

Taking into account all cases of tuberculosis without selection which have been treated by me and others in the first few years, the result is shown that 70% to 75% of all patients treated, have been permanently cured or have shown improvement for a considerable length of time. Of authors who confirm these favorable results may be mentioned: Schottin, Moschowitz, Gortschavenko, Heusser, Hessen, Azmanova, Exaquet, Lowski, Wassilenko, Mann, White, Frieser, Ewald, Humbert, Weismann, Hoedlmoser, Kraemer, Guisset, Pollak, Holm, Guttmann, Bloch, Katzenstein, H. Krause and others.¹

A few words are to be devoted to those cases in which extensive destructive lesions leading to formation of cavities have occurred. In the minority, as mentioned above, the cavities heal out. The majority, however, do not heal, because the thoracic wall does not retract; like the emphysema cavities they do not heal for mechanical reasons, because the shrinking of the lung tissue within the unyielding thoracic wall does not suffice to bring about the closure of large cavities. During the last few years I have submitted these cases to the thoraco-plastic operation in addition to the hetol treatment.² I have, up to the present time, operated only on cases which were otherwise hopeless. In all I have operated on six cases, following strictly one method with the exception of a

¹ An accurate collection of literature on hetol (cinnamic acid treatment) from the years 1888-1901 may be found in Dr. Cantrowitz's work, in Schmidt's *Jahrbuecher der Medicin*, August and November, 1901 (76 references).

² Vgl. *Berichte der Naturforschersammlung zu Karlsbad*, Sept. 21-26, 1902.

few occasional operations previously performed. The cases are detailed, so that an opinion may be formed:—

Case 1—Young woman, 25 years old, ill since five years, cavities, right upper lobe, healed under hetol treatment. On left side, over upper and lower lobes, tinkling, partly metallic râles; over middle lobe moist râles. No improvement for three months. Temperature 38.5°C. On 20th of November, 1901, resection of second to eighth rib. Recovery, in commencement, impeded by trouble with heart; then convalescence occurred. Up to October, 1902, increase in body-weight 18 pounds. On left side only dry râles; about 10 c. c. of sputum daily.

Case 2—Young girl, 15 years. Rapid development of tuberculosis at puberty. Râles in left upper lobe disappeared under hetol treatment, as well as the râles in the middle portions of right lung. Increase in weight 23 pounds. Tinkling râles in right apex persist; after contracting a cold, decrease in weight, temperature to 38.2°C. February 13, 1902, resection of first to fourth ribs, right side anteriorly. Good recovery. Since June no further expectoration. Reëxamination, September 30th. Increase in weight 15 pounds, since operation; at right apex harsh breathing, no râles.

Case 3—Man, 23 years. Rapidly progressing lesions in right lower lobe. June, 1901, dry râles in right upper and lower lobes; here some moist râles to be heard; frequent haemorrhages. No hetol. In November reëxamination. Large cavity in right lower lobe with amphoric, bronchial breathing, tinkling râles. Under hetol treatment cessation until spring 1902. Operation May 1, 1902. Resection of fourth to ninth ribs, right side. Two weeks after the operation acute pneumonia in left lower lobe. Recovery very slow, as well as disappearance of râles in left lower lobe, posteriorly. Until end of October, 1902, increase in weight 6 pounds; general health not entirely satisfactory. If the intercurrent pneumonia had not arisen the result would probably have been better. Possibly removal of a larger portion of the ribs might have been advisable.

Case 4—Woman, 22 years. In a few months an enormous expectoration has developed, about 500 c. c. daily, which is only insufficiently brought up under suffocative attacks of cough. No tubercle bacilli in sputum. Right and left upper lobes show relative dullness, a few dry, partly moist râles over both lungs. In left lower lobe, absolute dullness over an area of 15 cm. with numerous large bubbling partly tinkling râles. June 30, 1902, resection of fourth to ninth ribs on left side posteriorly. In the next few days purulent masses could only be expelled by means of emetics. On the fourth of July, opening of cavities with platinum cautery. Copious evacuation. Rapid decrease in the quantity of the sputum and improvement in general health. From July 15 hetol; discharged August 20. Sputum only 20 c. c. October 20, reëxamination: Below the retracted cicatrization absolute dullness, few dry râles, greatly diminished respiratory sounds. Occasionally dry râles in the rest of the lung; here and there a ronchus. Sputum 5 to 10 c. c., not purulent. Condition generally good.

Case 5—Man, 21 years. Four months ago received contusion in left lower thoracic region by knocking against edge of a plank; slowly developing abscess which was opened by another physician. May, 1902, hetol treatment. Left upper and left lower lobe, dullness. Fistula closed within a short time; immediately enormous increase of the purulent sputum (250 c. c.), which contained tubercle bacilli in small numbers. Tinkling râles in the left anterior, inferior thoracic region. Sup-

position of a cavity which had perforated chest wall in left lower lobe, which, with closure of fistula ceased to drain through chest wall. June 30, 1902, resection of fourth to ninth ribs; numerous punctures of lung made without discovering cavity. Rapid closure of the wound; great retraction of the entire left side. Decrease of the sputum to 40 to 50 c. c., no tubercle bacilli; general health satisfactory. Still under treatment.

Case 6—Woman, 28 years. Father and sister died of tuberculosis. Ill for last five years. For last three years, hetol at intervals. Apart from signs of cavity in left upper lobe, all manifestations of disease disappeared. Able to work; desires operation. June 26, 1902, resection of first to fourth ribs, left side posteriorly. Slow recovery. In October, dry râles left upper lobe, decrease of sputum; condition satisfactory, still under treatment.

Thus, of six hopeless cases two temporarily recovered, one greatly improved, two improved, one of which is still under treatment, one did not improve or became worse after operation. It is remarkable how well the patients have borne the operations. The justification of operative interference appears to be established in cases of stationary or slowly developing destructive changes and especially in cases of tuberculosis in the lower lobes, which offer such an unfavorable prognosis.

In other forms of tuberculosis the hetol treatment yields the following results:

Laryngeal tuberculosis offers a good prognosis so long as it is comparatively isolated, i. e., if it is associated with but moderate changes in the lungs. The prognosis is unfavorable if the affection in the larynx develops late, in connection with extensive pulmonary involvement. Patients with laryngeal tuberculosis require large doses (20 to 25 mg.) of hetol.

Tuberculosis of the intestine presents a favorable field for the action of the remedy. Even if fever is present the prognosis is not bad, if the state of health is not too poor. It must be observed that during the treatment signs of intestinal stenosis may appear.

In the treatment of renal tuberculosis with hetol the tubercles undergo cicatricial changes, but upon the coëxisting; purulent catarrh it has no influence; therefore the clinical results in these conditions are negative. Simple tuberculosis of the bladder yields a somewhat better prognosis. Very good results and permanent cures are obtained in tuberculosis of the epididymis and vas deferens. Abscesses must be opened and drained. Large doses are required—20 to 25 mg.

Tuberculosis of glands and scrofulous processes yield mostly favorable results, although some cases are very tedious and demand treatment over a period of six months to one year. Suppurating glands are to be curet-

ted and to be dusted with hetokresol (cinnamyl metakresol) and to be drained.

Surgical tuberculosis gives also a good prognosis; alternately a 1 per cent. solution is injected intravenously and a 5 per cent. solution locally into the fungous masses (one c. c. at a given point). Suppuration is not influenced by hetol. Space will not permit an extensive discussion of this subject. Tuberculous wounds heal rapidly when dusted with hetokresol (cinnamyl metakresol).

Tuberculosis of the skin and lupus heal nicely by means of cutaneous injections of an alcoholic solution of cinnamic acid (acid cinnamyl 1 part, alcohol 19 parts). The treatment, however, is tedious and tiresome.

In cases of brain tuberculosis no improvement has ever been noticed.

From the foregoing there is no doubt that the hetol treatment sufficiently early and properly employed can be of great service in combating tuberculosis, and that in the hands of a specially skilled physician material improvement and cure can be brought about even in advanced cases. Such active procedure in the treatment of tuberculosis may appear strange to some who are satisfied with placing their patients upon reclining chairs in the open air, and who leave all the rest to providence.

THE URINARY CALCIUM EXCRETION IN TUBERCULOSIS *

BY ALFRED C. CROFTAN, M. D., CHICAGO.

This paper constitutes a fragment of a more comprehensive investigation into the antagonism manifestly existing between the gouty diathesis and tuberculosis; the results obtained in this particular research into the "demineralization" of the tuberculous soil are sufficiently suggestive to warrant publication in this preliminary form; they promise to be of some value in the early diagnosis of tuberculosis.

Among the products manufactured by the tubercle bacillus both *in vitro* and *in vivo* is a peculiar proteid body closely allied to peptone (deutero-albumose). This substance has been found in the bodies of the bacilli themselves and in culture media in which tubercle bacilli had grown (Kühne, Hahn, Koch, Matthes). Kühne showed that the injection of this deutero-albumose manufactured from bacilli, produced a typical rise of temperature in tuberculized animals; Matthes found this albumose in Koch's tuberculin and discovered it in the urine after tuberculin injections; finally, he succeeded in producing a "tuberculin reaction" with deutero-albumose manufactured from egg-albumen without the intervention of tubercle bacilli. Rouques produced a tuberculin reaction with tuberculous urine and v. Jaksch found deutero-albumose in such urine. Kossel finally found it in tuberculous sputum and Matthes in tuberculous lymph-glands and in caseating and calcified tuberculous foci in the lungs.

It appears, therefore, that this deutero-albumose is one, if not *the* pyretogenic principle of the tubercle bacilli and of Koch's tuberculin, and that it is excreted in the urine and sputum of tuberculous subjects

In attempting to manufacture some deutero-albumose for the purpose of further experimentation with this interesting body it was found impossible to obtain a product that was altogether free from calcium. It is easy to remove the other inorganic constituents that cling to deutero-albumose, but calcium adheres with great tenacity, so that it cannot be removed by mechanical means (dialysis, precipitation with alcohol, etc). By chemical means only (ammonium-oxalate) can the calcium be removed and a calcium-free albumose be obtained.

This finding suggested that deutero-albumose has a selective affinity for calcium, a proposition that was borne out by the following three tests:

*Read before the Philadelphia Pathological Society, March 7, 1902.

1. If a dilute solution of a calcium-salt is added to a solution of decalcified deuterio-albumose, a definite proportion of the calcium will be bound so tightly that it *cannot again be removed* by physical means.¹

2. If two test tubes are filled with equal quantities of milk and to one tube is added ordinary deuterio-albumose, to the other the decalcified preparation, and rennet is added to both, the curdling of the milk will be considerably retarded in the latter tube. If sufficient decalcified albumose is added, curdling is inhibited. The calcium of the milk is evidently bound so tightly to the albumose that paracasein-calcium (curdle) cannot be formed.

3. If blood is carefully decalcified by the addition of a calculated portion of oxalate and equal portions of this blood are distributed in a number of tubes and varying quantities of decalcified deuterio-albumose added to each tube, it will be found on addition of a definite number of drops of a calcium solution to these mixtures that coagulation is retarded or inhibited in proportion to the quantity of decalcified deuterio-albumose added to each tube. Deuterio-albumose therefore has a greater affinity for calcium than has para-thrombin; consequently the formation of calcium-parathrombin, i. e. fibrin, is prevented.

It may also be mentioned that in osteomalacia the excessive calcium excretion is accompanied by albumosuria.

If, now deuterio-albumose has such a selective affinity for calcium and if deuterio-albumose is formed and excreted in tuberculous subjects, then we should expect to find some relation between the formation of and excretion of deuterio-albumose in such subjects and the localization and excretion of calcium. As a matter of fact I need only refer to the calcification of tuberculous foci to point out, what may be coincidence, that calcium is commonly found where deuterio-albumose is formed by the action of tubercle bacilli.

In regard to the excretion of calcium in tuberculosis that might be expected to proceed *pari passu* with the excretion of deuterio-albumose, little is known. The only statement I find in the literature is enunciated by no less an authority than Senator² who says: "It is a positive fact that in pulmonary phthisis an abnormal quantity of calcium is excreted in the urine even if little food is administered and if the patients suffer from diarrhœa."

In view of the practical importance in the diagnosis and possibly in the prognosis and therapy of tuberculosis that this sign promised to assume I undertook to verify my theoretic postulate and Senator's isolated statement.

It must be remembered that the excretion of calcium in the urine is no true index of the total excretion of this element, for the bulk leaves

¹ For the numerical and other details I refer to the exhaustive treatise mentioned above, which is to be published shortly.

² *Centralblatt f. inn. med. Wiss.*, 1877, p. 389.

the body via the intestine; ninety to ninety-five per cent. of calcium-salts, administered by the mouth, reappear in the fæces; the greater portion is not absorbed at all (Voit, Hoppe-Seyler) and of the small portion absorbed a large percentage is carried back to the bowel. At the same time some 5 to 10 % of the calcium ingested always reappears in the urine (Saborow, Riesell, Schetelig).

I was able to verify this fact in a case of a patient with aortic aneurism, who was kept for several weeks on a constant Tufnell diet and received 10 gr. of calcium chlorid in capsule three times a day. The urine was sent me for this study by courtesy of Dr. A. Stengel.

What applies to calcium entering the circulation from the stomach and intestines must apply to calcium entering the circulation from other sources. If then in tuberculosis we should find only a slight increase of the urinary calcium, we may assume that the total, i. e., urinary and intestinal excretion, is considerably increased, viz., as 5 to 95.

I need hardly emphasize that in order to possess any value whatever the diet must be constant for a period of weeks: only if this premise is fulfilled can fluctuations in the urinary calcium excretion be utilized. Constant diet also presupposes essentially constant blood-reaction and phosphate-content, all factors that influence calcium excretion.

The first experiments were made in a dog which was tuberculized and kept on a constant diet. An emulsion of a pure culture was injected into the jugular vein by Dr. Ravenel; the culture was the eighth-generation of a bacillus derived from a mesenteric gland in a child. Mr. W. H. Barlow performed the calcium analysis for me according to the method given below,* and reports the following figures:

| DATE | CaO |
|---------------|-------------------|
| Dec. 5, 1901, | not determinable. |
| Dec. 9, | 0.001 |
| Dec. 13, | 0.006 |
| Dec. 16, | 0.0078 |
| Dec. 18, | 0.0107 |
| Dec. 23, | 0.0042 (low) |
| Jan. 7, | 0.0203 |
| Jan. 11, | 0.0510 |
| Jan. 12, | death. |

*SCHEME FOR THE ANALYSIS OF CALCIUM IN URINE.

Take sample of 100 c.c. urine; evap. to dryness in presence of 2 c.c. HNO_3 . Add H_2O and HNO_3 and evaporate to dryness to decompose the carbonaceous matter. The phos. acid in the sample should now be in the ortho-form.

Add a little water to residue in the evaporating dish, filter, ignite and fuse with Na_2CO_3 . Add mass to filtrate. Ppt. P with Ag_2CO_3 ; filter. Free filtrate from Ag with HCl . Have sol. concentrated and add 50 c.c. NH_4 oxalate sol. to ppt. Ca. Dilute to about 500 c.c., bring to boiling, cool, add NH_4OH , filter, ignite, and weigh Ca as CaO .

An analysis of this table shows a more or less progressive increase of the calcium excretion from traces so small that they could not be quantitatively determined to 0.0510 g., the day before the dog's death from general miliary tuberculosis (autopsy finding). The low figure on Dec. 23rd cannot be explained; it is possible that it was due to a technical error.

Whereas an isolated series of determinations is by no means conclusive, it was sufficiently suggestive to warrant analysis of a number of cases of human tuberculosis urine. Here the same method of calcium-determination was pursued; the method, while complicated, precludes error and gives absolutely reliable results. Many of these examinations were also performed by Mr. Barlow. I wish to thank him in this place for his assistance.

A summary of the results shows that in cases of advanced phthisis with destruction of lung tissue the excretion of calcium is markedly increased (in one case as high as 0.47 g. CaO. (normal 0.2 to 0.3 g. CaO.) *pro die*. This high figure remained constant. In one case of apical tuberculosis without cavity formation the calcium figure was also higher than normal for a period of three weeks, during which the patient was under observation (0.37 to 0.41 g. CaO.)

From a diagnostic point of view it would be particularly important to determine an increase of calcium excretion during the "prebacillary" stage. From 1899 to 1900 I had occasion to study some fifteen cases of suspected phthisis in this direction and was able to verify that in six of them the calcium excretion reached figures that were either near the high normal or above the normal mark. Four of these cases later presented distinct evidence of tuberculous infection.

It is a difficult matter in private practice to induce such patients to live a uniform life and to eat a constant diet for a period of weeks; where this can be done, however, I consider *a high and increasing calcium content of the urine a suspicious sign of tuberculous infection*. This subject calls for further elaboration and amplification. The results obtained so far bear out the theoretical views advanced above.

It is interesting to inquire why deuterio-albumose combines with calcium and whether this reaction is part of the protective activity of the organism against tuberculous invasion. Is the calcium-albumose less toxic, less pyretogenic than the decalcified product?. An opportunity presented itself through the courtesy of Dr. Leonard Pearson to inject calcified deuterio-albumose into a herd of 20 cattle that were known to be tuberculous, having reacted to the tuberculin test some months previously. Deuterio-albumose, prepared according to Matthes and *known to pro-*

duce pyrexia in tuberculous animals, was dissolved in water and saturated with calcium by the addition of a 10% solution of calcium-chlorid. The calcified albumose was precipitated with alcohol, filtered off and dried. A specimen contained 4.89% of calcium. Of this product a 5% watery solution was injected into the above-mentioned herd and *no temperature reaction was obtained* as shown by the following table:

| No. of Animal | Temp. before Injection | | DATE, | | Temperatures after Injection. | | | | | |
|---------------|------------------------|---------------|--------------------------|--------------------|-------------------------------|--------------|--------------|--------------|---------------|------------|
| | Date, February 21st. | | Deutero-Albumose Solut'n | Time of Injection. | Date, February 22nd. | | | | | |
| | Time: 6:30 | Time: 8 p. m. | | | Time 2 a. m. | Time 4 a. m. | Time 6 a. m. | Time 8 a. m. | Time 10 a. m. | Time 12 m. |
| 1 | 101.2 | 101.4 | 4 c. c. | 8 p. m. | 101.2 | 101.6 | 101.3 | 102. | 102.4 | 102.4 |
| 2 | 101. | 100.6 | 4 " | " | 100.5 | 100.6 | 101.4 | 101.8 | 101.9 | 101.9 |
| 3 | 101.3 | 101.8 | 4 " | " | 101. | 101. | 101.3 | 101.4 | 102.2 | 102.6 |
| 4 | 102.2 | 102.4 | 4 " | " | 102. | 102. | 102.2 | 102.1 | 102.4 | 102.4 |
| 5 | | | | | | | | | | |
| 6 | 102.2 | 101.6 | 2 " | " | 101.6 | 101.9 | 101.8 | 102.2 | 102.6 | 102.2 |
| 7 | 101.6 | 100.2 | 2 " | " | 101. | 101.4 | 101.4 | 101.6 | 101.4 | 101. |
| 8 | 102.4 | 101.2 | 2 " | " | 101.6 | 101.8 | 101.6 | 101.6 | 102.6 | 102.9 |
| 9 | 103.2 | 102.6 | 2 " | " | 102.4 | 101.6 | 102. | 102. | 102.4 | 102.2 |
| 10 | 101.6 | 101.1 | 4 " | " | 101.4 | 101.3 | 101.4 | 101.9 | 102. | 102.1 |
| 11 | 100.8 | 100.8 | 4 " | " | 101. | 101. | 101.9 | 102.2 | 102.6 | 102.6 |
| 12 | 103. | 103. | 4 " | " | 101.3 | 100.6 | 101.6 | 101. | 101.4 | 101.6 |
| 13 | 101.2 | 100.6 | 4 " | " | 101.1 | 101.2 | 101.4 | 102.2 | 101.9 | 101.8 |
| 14 | 101.1 | 101.2 | 5 " | " | 101.2 | 101.1 | 101.6 | 102.4 | 102.4 | 102.4 |
| 15 | | | | | | | | | | |
| 16 | 102.2 | 102. | 5 " | " | 101.9 | 101.4 | 101.6 | 102. | 101.6 | 103. |
| 17 | | | | | | | | | | |
| 18 | 100.8 | 101.6 | 6 " | " | 100.8 | 101.5 | 101.8 | 102.2 | 101.8 | 102.2 |
| 19 | 102. | 102.1 | 8 " | " | 101.6 | 100.9 | 101.2 | 101.6 | 102.4 | 102.2 |
| 20 | 101. | 101.5 | 10 " | " | 101.2 | 101.6 | 101. | 101.6 | 101.6 | 101. |

Are we justified in assuming that the addition of calcium to the deutero-albumose molecule robs it of its fever-producing power?. Is this a disintoxicating process and does it occur in the organism when calcium is attracted to the albumose generated by the tubercle bacillus *in loco*, or when it enters the circulation in combination with deutero-albumose and is excreted in excess in the urine?.

If this theoretic postulate, which is borne out by a few facts, is correct, the *administration of calcium salts should be of benefit* in the treatment of tuberculosis.

THE EARLY DIAGNOSIS OF TUBERCULOUS LARYNGITIS.*

BY RICHMOND MCKINNEY, M. D.

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To those of us who have observed the ravages of consumption in the throat, and who have witnessed the speedy fatal termination of cases so afflicted—and what practitioner of medicine has not had his share of experience with these cases—the importance of the subject to which I am briefly to call your attention this evening is an ever present realization.

It is an unfortunate fact that the throat specialist rarely sees a case of tuberculous laryngitis until it has advanced to a stage in which the therapeutic resources at his hands are practically fruitless. And yet there is offered to these cases some chance of palliation and perhaps healing when they are more opportunely seen. It is true that it is but rarely that we can make a positive cure in these cases, and we must agree with the French teacher who said "*il est mort guéri*," for they nearly all invariably die ultimately of the precedent pulmonary tuberculosis of which the laryngeal development is but an incident. Primary laryngeal tuberculosis, of which a very few cases have been reported, with an occasional "cure," without later manifestations in the lungs, is still too rarely recognized to be counted as a factor in any discussion.

It is not to be expected that the general practitioner shall possess the requisite experience in the use of the laryngoscope that is necessary to obtain a picture of the local manifestations which indicate invasion of the larynx by the bacillus tuberculosis, for even were he measurably expert in viewing the larynx in this manner, it would require much practical application in observation of the various laryngeal lesions to enable him to differentiate at times even an advanced tuberculosis from other ulcerative conditions, to say nothing of the slight changes which indicate a developing tuberculosis.

It cannot be stated that laryngeal tuberculosis exhibits a routine series of changes in the larynx, for its course may be thoroughly atypical, and its manifestations so protean as to cause even the most experienced laryngologist to hesitate in giving a positive opinion. We are told

*Read by invitation before the Humboldt Medical Society, Humboldt, Tenn., September, 2, 1902, and also before the Mississippi County (Ark.) Medical Society, Osceola, October 8, 1902.

to look for a decided and characteristic pallor of the mucous membrane covering the tissues of the larynx as an early premonitory symptom of beginning tuberculosis, but how often have I found that a stage of congestion precedes that of anemia. A case that could easily have been confusing is the following:

On August 13, present year, Dr. John M. Maury, of Memphis, referred to me for examination Mr. L. M., of Memphis, aged twenty-one years, who gave the following history:

Has been spitting up blood at intervals for about a month, this having occurred about three times, usually following contraction of a cold. Has never had any fever or night sweats. Father and mother both living and in good health. No history of tuberculosis in any member of the family. My report to Dr. Maury as to the source of the bleeding was as follows:

"The nasopharynx presents several tortuous and congested superficial blood vessels; the epiglottis is intensely reddened and exhibits blood vessels on its superficial border which evidently have recently been bleeding; both arytenoid cartilages are similarly inflamed, and I notice several hæmorrhagic spots on these." A tentative opinion given by me after examination was that, in the absence of anything to indicate a tuberculous origin of this hæmorrhage, the erosions observed were catarrhal in nature. The next day I had an opportunity to examine this patient more thoroughly, and the result was a material change in the opinion as expressed the day before, which was induced by the evidence further developed in the case. When examined at this time the larynx had lost considerable of the congestion that it exhibited the day before, giving way to the characteristic pale color which makes us so suspicious of beginning tuberculosis. The same tortuous vessels and hæmorrhagic spots were to be seen, and were really brought out more prominently by the increased paleness of the surrounding tissues. But what chiefly influenced a doubtful prognosis is the fact that the patient was found with a temperature of $100\frac{3}{4}^{\circ}$ F. with a pulse rate of only 72. Nothing decided was found in his lungs. My opinion as then given was that we should be very suspicious of the nature of the lesion in this patient's case. Since then he has had a regular afternoon rise of temperature, to about 100° F. and his parents, on the advice of the family physician, sent him west.

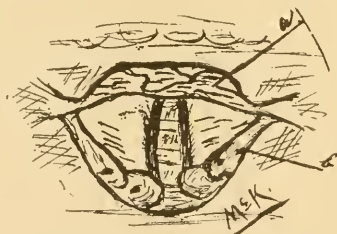


FIG. 1. *a.* Epiglottis congested and vessels swollen and tortuous. *b.* Hæmorrhagic spots.

In this case (*Fig. 1.*), while there was no positive evidence of tuberculous infiltration in the larynx, the value of a laryngoscopic examination in arriving at a diagnosis is not to be underestimated, and the prompt

action of the attending physician in securing such, aided materially in justifying a conclusion that this must be regarded as an indication of incipient pulmonary phthisis. The varying laryngeal picture here shown might have led to a diagnosis of beginning tuberculosis.

In advanced phthisis laryngea, with the constant cachexia, fever, night sweats and general emaciation characteristic of pulmonary tuberculosis which are always present, the question of diagnosis rarely occurs, but in cases such as that just cited, early diagnosis is often difficult, and is of paramount importance.

The general practitioner will ask for rules of diagnosis which do not involve the application of the art of laryngoscopy, and he will feel that he is but poorly equipped for this purpose with the few general symptoms that can be mentioned. But there are some symptoms the occurrence of which should place him on the *qui vive*, and should forewarn him of possibilities that may lead him to seek the higher diagnostic skill of the special worker in this particular field of medicine.

A safe general rule is that when there is a persistent laryngeal catarrh, evidenced by hoarseness, which does not yield to ordinary measures, it should be regarded with suspicion, and the family history of the patient closely investigated, and his lungs minutely examined. Further observation of such patients, which should religiously be carried out, may lead to developments that will justify securing expert opinion, or advising a change of climate.

Another symptom constantly complained of in the early stage of laryngeal tuberculosis is a peculiar sticking sensation in the region of the larynx. Patients will perhaps complain of this symptom more than any other.

Dysphagia also comes on sometimes very early in the development of this disease, but usually is caused by some later ulceration of the larynx, particularly of the epiglottis.

In most of these cases there will be one or more of the common symptoms peculiar to the pulmonary lesion, such as fever in the afternoons, night sweats and beginning emaciation, but even where the pulmonary signs are well developed, the importance of early recognition of a beginning laryngeal ulceration is realized by those who understand how very much can be done toward retarding the development of this process, and thus rendering comfortable and prolonging the existence of such sufferers.

It does not necessarily follow that a secondary laryngeal tuberculosis should be consecutive to a tuberculous infiltration of the tissues of

the lungs, for it is now recognized that the focus of origin may be found in some portion of the glandular tissues, such as the faucial or pharyngeal tonsils, extending thence through the lymphatics to the larynx. A rather unique case of lymphatic extension was reported by me to the Tri-State Medical Association at its meeting in Memphis, December, 1898, and published in the *Memphis Medical Monthly* for January, 1899. This case should be sufficiently interesting for you to condone the liberty that I take in trespassing on your time in order to report it.

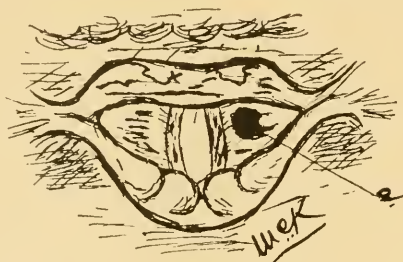


FIG. II. *a*. Tumefaction of left ventricular band.

In November, 1898, Dr. F. D. Smythe, of Memphis, referred to me a man aged thirty years, in the employ of the Memphis Street Railway Company, who had the following history:

When first seen by Dr. Smythe in May, 1898, the patient bore the appearance of good health, and had a clear family history, but presented himself for relief from a gradual enlargement of the axillary lymphatic glands, which he had been noticing about two months. Consenting to operative measures, these enlarged glands, so far as could be judged, were thoroughly removed, and on examination a number of them were found to have undergone cheesy degeneration. The wound healed slowly, with some local infection resulting, and gradually cicatrized. Two months after the operation the patient presented himself with enlargement of the infra-clavicular glands; also enlargement of the lymphatics along the free border of the pectoral muscle down to the nipple of right side. A free incision was made from the axilla to the nipple, and the glands, which had broken down, were removed. An incision was also made below the clavicle of this side, and the removal of several large cheesy glands effected. The patient recovered rapidly from this operation, and in the course of six weeks gained twelve pounds. A few weeks later, he again presented himself to Dr. Smythe, complaining of fullness, with a sticking sensation about the larynx, and a hacking cough with no expectoration. Examination of his lungs revealed no apex catarrh or other indication of tuberculous deposits. At this time the patient, through the courtesy of Dr. Smythe, came into my hands for laryngoscopic examination. With the mirror I found the larynx pale, the arytenoids swollen, and the left ventricular band, anteriorly, presented a slight tumefaction (*Fig. 2.*), suggestive of infiltration. In this instance, there being no hectic when I saw the case, and the man to all appearances enjoying good health, I should most likely have overlooked a diagnosis of beginning tuberculous infiltration of the larynx but for the previous history of the tuberculous

glands. I saw this patient but two or three times, and since no ulceration was present, points of infiltration not having broken down, gave him no treatment other than that prescribed by his physician, Dr. Smythe, who had him on cod liver oil and hypophosphites. The man afterwards went to Texas, where, when last heard from, he was enjoying good health.

It commonly devolves upon the general practitioner to see these cases first, and it is more with a view to outlining some general rules of diagnosis, and of impressing upon my hearers the necessity for prompt recognition of these cases, that I have prepared this brief paper. It will be apparent to you all that a diagnosis early in this disease must necessarily be obscured by the possibility of its being one of several conditions with symptoms indetical with those of a tuberculous laryngitis, but it is the persistence of the symptoms of the latter condition which will awaken our suspicions. The fact that a laryngitis may be syphilitic in nature should also be borne in mind, and unless there develop positive indications of tubercle invasion, the diagnostic quality of potassium iodide should be invoked in all cases of unresponsive laryngitis, regardless of personal history. A question of cancer should rarely present itself for exclusion, the age, physical condition of the patient and other well known features of this disease being sufficiently diagnostic.

METHYLENE BLUE IN CONSUMPTION.

BY DR. HENRY HERBERT, PHYSICIAN IN CHARGE OF THE
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Methylene blue or tetramethylthionine-chloride (*U. S. P.*), $C_{16}H_{18}N_3SCl$, has not been used extensively in phthisis; among other diseases in which it has been more or less employed may be mentioned carcinoma, sarcoma, nephritis, diphtheria, gonorrhœa, cystitis and malaria. Dr. Austin Flint¹ used it in chyluria due to filaria sanguinis, U. W. E. Thur.² even in beri-beri; P. Ehrlich,³ employed it as an analgesic; Combemale and Francois⁴ published exhaustive investigations upon this drug and recommended it in neuralgia. P. Gutmann and P. Ehrlich⁵ recommended it in malaria.

I had occasion to use it in a case of malaria associated with consumption and was surprised to find the latter disease more benefitted by it, than the disease for which the drug was intended. I therefore began to treat several cases of phthisis with methylene blue at the Montefiore Home Sanitarium; these cases, nineteen in all, indiscriminately selected, in various stages received the remedy in doses of from $\frac{1}{2}$ gr. to 3 gr. three times a day.

For the careful clinical observation of the following cases, I am indebted to Dr. I. R. Shapiro, assistant resident physician of the sanitarium:

Case 1. G. J., 26 years; infiltration of both superior pulmonary lobes, in a chronic advanced stage. Condition before medication: Intense cough; amount of sputum in 24 hours about 7 ounces; dyspnœa, nightsweats, weakness, slight fever, sleep disturbed by spells of coughing. Duration of treatment, 7 weeks and 5 days.

After one week's treatment the cough was greatly diminished and the amount of expectoration was reduced 30%; appetite improved, sleep undisturbed. Patient felt stronger and after treatment of 5 weeks' duration amount of expectoration less than one half of the original amount; number of bacilli greatly increased; no effect on temperature noticed. Gain in weight four pounds. Patient is still in the sanitarium.

Case 2. O. W., 20 years. Infiltration of left lung, in an advanced stage; tem-

¹ *New York Medical Journal*, 1895.

² *Schmidt's Jahrbucher*, 1893.

³ *Deutsche Medicinische Woch.*, 1890.

⁴ *Compt. nar. hebdom. des seances et mem. de la Soc. de biolog.*, 1890.

⁵ *Berl. klin. Woch.*, 1891.

perature ranges between 96.8° and 105.2° F. Troublesome cough, profuse expectoration, weakness, poor sleep. Medication :

From Dec. 20, 1901 to Dec. 29, 1901, gr. I. t. i. d.

From Dec. 29, 1901 to Jan. 5, 1902, gr. II. t. i. d.

From Jan. 5, 1902 to Jan. 20, 1902, gr. III. t. i. d.

Result : Expectoration reduced to half of former amount and remained so for a short time after Jan. 16. No effect upon temperature which ran even higher. Number of tubercle bacilli increased. Patient is still at the sanitarium and doing well.

Case 3. H. K., 42 years. Infiltration of upper lobe of left lung with cavity and tuberculosis of the larynx (far advanced). Temperature between 98.2° and 103.4° F.; great weakness, emaciation, hectic condition, night sweats, diazo-reaction positive.

Methylene blue was given for four weeks in gr. I dosis three times a day. No improvement; *exitus letalis*.

Case 4. R. H., 19 years. Infiltration of entire right lung, in advanced stage. Temperature between 97.8° and 101.4° F. Dyspnoea, distressing cough, poor sleep, general debility, expectoration of 8 ounces in 24 hours. Treatment with methylene blue for 6 weeks and 6 days.

Result : Cough lessened, expectoration decreased 50%, fall of temperature by 1° F., number of bacilli increased. Sleep and appetite improved; gained 6 pounds in weight.

Case 5. S. G., 29 years. Infiltration of entire right lung and upper lobe of left lung; chronic, advanced case. Cough harassing, expectoration amounts to 6 ounces in 24 hours. *Foetor ex ore*, poor sleep and headaches. Treatment lasted 6 weeks and 6 days.

Result : Expectoration decreased by one third, headache disappeared, sleep improved, breath became odorless. No effect upon temperature, number of bacilli increased; gain in weight 4 pounds.

Case 6. S. W., 15 years. Infiltration of entire left lung; advanced stage. Cough harassing, expectorates about 3 ounces daily, sleep disturbed, weakness, slight rise of temperature.

Four weeks treatment with methylene blue had no effect. Number of bacilli increased.

Case 7. M. R., 41 years. Infiltration of left lung, chronic advanced case. Troublesome cough, especially during nights; expectoration amounts to 9 ounces; weakness, slight temperature rise.

Treatment lasted 6 weeks; after a few days only, expectoration decreased by one third, sleep improved, gained in strength, but *dyspnoea increased*. Number of bacilli slightly increased; lost one pound in weight.

Case 8. N. L., 29 years. Infiltration of both lungs with consolidation and cavity in upper lobe of right lung; tuberculosis of larynx; far advanced case. Suffers from very troublesome cough, day and night, expectorates about 10 ounces in 24 hours; dyspnoea, weakness, diarrhoea, poor sleep, etc. Temperature ranges between 99° and 101.2° F. Treatment with some interruption lasted altogether 10 weeks and 4 days. Dosis beginning from gr. I, t. i. d. ending with gr. III, three times a day.

Result : Cough greatly alleviated after 5 days, expectoration diminished by half the amount during the day and by 75% during nights, sleep therefore much improved, but dyspnoea increased. General strength and digestion greatly improved, temperature remained the same, number of bacilli increased. The improvement remained

60 days after discontinuing the treatment; cough and expectoration then assumed former intensity. Gained 2 pounds in weight.

Case 9. Miss S. L., 20 years. Infiltration of right apex. Hysteria. Incipient case without fever. Treatment after 11 days discontinued, without effect.

Case 10. L. R., 49 years. Infiltration of upper lobe of right lung, emphysema, chronic advanced case. Treatment after three weeks discontinued; result negative.

Case 11. A. A., 30 years. Infiltration of entire right lung, cavity in left lung, far advanced case. Treatment after two weeks discontinued; result negative.

Case 12. B. T., 33 years. Tuberculous laryngitis; diffuse foci in both lungs, advanced case; treatment discontinued after two weeks, expectoration slightly reduced.

Case 13. Mrs. A. W., 25 years. Infiltration of upper lobe of left lung and right apex. Treatment after nine days discontinued. Sensation of "choking" experienced.

Case 14. Mrs. F. H., 32 years. Right apicitis, neuralgia brachialis. Treatment lasted five weeks and neuralgic pains were distinctly benefitted by methylene blue, only to reappear after the discontinuation of the drug. Gain in weight 2 pounds.

Case 15. Miss J. R., 21 years. Infiltration of upper lobe of left lung; treatment after nine days discontinued; result negative.

In three other cases treatment had to be discontinued after a few days, with remaining sensation of "choking." In another case of hæmaturia due to tuberculosis of kidney and bladder (after operation) the amount of blood was considerably reduced.

In the cases cited above and in a few more, not particularly mentioned, it has been observed, that methylene blue causes in larger doses nausea and even vomiting; nearly all cases complained of stranguria, which subsided after a short period; in most of the cases it produced a sensation of "choking."

No doubt methylene blue is a drug which impedes the expectoration of the contents of the bronchial tubes, thus causing a sensation of "choking" or even dyspnoea. Methylene blue reduces the muco-purulent sputum to a mere purulent sputum, the mucoid part of the sputum is thereby retained or absorbed and its discharge decreased. Therefore the sputum becomes more concentrated and thus shows an enormous increase of bacilli; but the drug has no local effect upon the tuberculous lesions of the lungs or of the throat; it has furthermore no influence whatever upon the temperature.

The only advantageous feature of the drug consists in reduction of the amount of expectoration and that it relieves the cough; it may therefore safely be administered in chronic advanced cases of phthisis with *profuse* muco-purulent expectoration. It is contra indicated in sensitive and in hectic cases.

TUBERCULOSIS OF THE CERVICAL LYMPH GLANDS.

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One needs but to glance at the evolution of the treatment of this form of tuberculosis to realize the great strides which modern surgery has made in this grave affliction of mankind. Thirty years ago the term *scrofula* was still applied to those conditions in which we have a chronic catarrhal inflammation of the upper respiratory tract, accompanied by an enlargement of the lymph glands of the neck, which sooner or later broke through the skin, discharging a caseous pus. Through the discovery of the tubercle bacillus and the light which modern pathology has thrown upon this subject, we are now enabled to state that in the majority of cases, in fact, in practically all, they are of tuberculous origin, and that an examination of the lymph glands shows the typical changes found in tuberculosis. Over ninety per cent. of the chronic enlargements of the cervical lymph glands are due to tuberculosis. The remainder to carcinoma (secondary); to Hodgkin's disease, and to lymphatic leucemia. When we take this large percentage into consideration, it would seem to be comparatively easy to make a diagnosis in every case. It will not be the object of this paper to discuss at length the pathology and recognition of this affection as much as its treatment. It may be said in general that when a case of subacute or chronic enlargement of the lymph glands, wherever situated, presents itself, the first point to be considered is that the infection is almost invariably secondary, and a careful search will usually result in finding a primary lesion.

The lymph glands act as filters or police stations for organisms, and this is as true of the tubercle bacillus as of pus organisms. In many cases an examination of the ear will reveal a chronic purulent discharge with a possible caries of the mastoid, as a primary trouble. In others a rhinitis of long-standing in an ill-nourished child, reared under poor hygienic conditions, will be found as the entrance point.

In a comparatively large number, the atrium will be situated in the oro and naso-pharynx. In the experience of the writer, adenoid vegetations and hypertrophied, diseased faucial tonsils play a very important

rôle in the etiology of tuberculous glands of the neck, and, as will be stated later, their removal is as important as an operation for tuberculous glands itself. It may be stated almost as an axiom that it is useless to operate for tuberculous glands of the neck if the primary atrium through which the tubercle bacillus enters and will continue to enter as long as it is present, is not removed. Hence in every case of enlarged glands of the neck a careful search should be made for the usual external and internal evidences of the presence of these diseased structures. For example, the history of mouth-breathing, especially at night; of a high arched palate; lack of development of the thorax, and of the upper half of the face, with the usual typical stupid expression accompanying the latter, must not be overlooked. The more cases of tuberculous glands of the neck one sees, the more convinced is one that unless abscesses and fistulae are present, there are few pathognomonic local findings which will distinguish tuberculous from other forms of subacute or chronic enlargement of the glands. The writer has examined cases which were referred with the diagnosis of tuberculosis, in which an examination of the blood showed a lymphatic leucemia. Another disease not to be forgotten in the differential diagnosis is Hodgkin's disease. In this the glands in other parts are often involved before those of the neck, especially those of the axilla. Not infrequently the number of glands involved in both Hodgkin's disease and lymphatic leucemia is greater and more apt to be bilateral than in tuberculosis. The enlargement of the cervical glands is frequently predominant, but in both of these two affections the axillary, cubital, mediastinal and inguinal are also enlarged, at times as much so as those of the neck. Above the age of thirty a chronic enlargement of the cervical glands may be secondary to an epithelioma of the lips, mouth or pharynx. I remember a case in Vienna in which there was an enormous involvement of the glands and apparently no primary lesion. The autopsy revealed an insignificant epithelioma at the base of the tongue. The glandular enlargement was out of all proportion to the size of the primary growth.

Lastly, one should never forget the possibility of such enlarged glands being an evidence of secondary or tertiary syphilis, especially in adults. A patient was admitted to the hospital recently with enlarged glands which seemed of a tuberculous nature. A thorough examination revealed a coëxisting syphilitic orchitis; both this and the glandular trouble rapidly cleared up after the use of potassium iodide.

The pathology is so well known that a few words must suffice. When the bacillus of tuberculosis invades the gland, the latter enlarges

through increase of its lymphoid elements. Throughout this hyperplastic parenchyma tubercles form. The glands may remain in this stage for years without breaking down. The bacilli become latent and can start up the process at any time in many cases. In the remainder, and these are the patients who recover without operation, the phagocytic action of the young tissue cells and lymph corpuscles conquers the bacillus and encapsulates it, as in the lung; the gland decreases in size and a cicatrix replaces the former tubercle.

In the other cases the battle between the tubercle bacillus and the gland tissues results in a victory for the former, and the tubercles caseate. In sections of glands made at the time of operation, one can see all stages of the process. In some, one notes four or five separate foci of caseation; in others these have coalesced to form one cheesy mass. As the process continues this liquefies, and a soft creamy pus is formed, the parenchyma is entirely dissolved, and the capsule of the gland acts as a mere shell for its now liquefied contents. Simultaneously with the intraglandular changes, a more or less extensive inflammation around the gland occurs. This periadenitis is an unwelcome pathological change for the surgeon. It causes the structures to be matted together. Veins and nerves are especially involved by these adhesions, and their presence greatly complicates an operation. These adhesions enable the glands to discharge the pus through the skin or into the veins, causing, in the former case, sinuses and resulting ugly scars; in the latter case, general miliary tuberculosis.

The treatment of tuberculous glands wherever situated should, in my opinion, be a radical one. When we remember that in more than twenty-five per cent. of all cases, pulmonary tuberculosis follows, they become, as von Bergmann has said, "a constant menace."

In but few cases after a diagnosis has been made is an expectant plan of treatment to be recommended. These exceptions are:

1. Those patients, children or adults, in whom an operation is not permitted on account of slight involvement of the glands.
2. Where the family history shows a strongly tuberculous tendency, and there are suspicious signs in the apices of the lungs.
3. In greatly debilitated, anæmic children, especially if complicated by a chronic bronchitis.

Under these conditions, the writer would advise a conservative treatment. Such patients ought to be sent to the seashore or to a high, dry climate. If this cannot be done, they should live out-of-doors as much as possible, take cod liver oil and creasote or the iodide of iron

(m. x. to 5 i t. i. d.). Their home surroundings should be made as hygienic as possible. This latter step is of the greatest importance in prophylaxis, because it is through the inspired air that the bacillus gains access to the nose and pharynx.

External applications, especially iodine, do more harm than good. They increase the periglandular inflammation, and do not have any direct influence upon the gland. If an operation is refused, one must be content with thorough curettage of broken-down glands and sinuses, and the use of iodoform. The latter is a true anti-tuberculous remedy, promoting tissue growth, and acting as an antitoxin. Both as a preliminary to expectant and operative treatment, one must urge the removal of adenoid vegetations, diseased faucial tonsils and carious teeth, as well as the thorough treatment of chronic inflammatory conditions in the ear and nose. I have had occasion to observe recurrences a number of times where these measures were neglected. As soon as the adenoids and tonsils were removed the process ceased. They are the fire and the enlarged glands the smoke, and we cannot expect to conquer the latter without quenching the former.

I shall not describe in detail the technique of operation. I believe that an accurate knowledge of the main anatomical points, perfect asepsis and a large incision, so as to expose every corner of the field, are indispensable. The hæmorrhage is surprisingly small, if care be taken to avoid injuring the internal jugular vein. The best incision is a longitudinal one over the middle of the sterno-mastoid muscle. After ligating the external jugular vein, the incision is continued down to this muscle which serves as a guide throughout the operation. The glands in front of it are first exposed, pulled away from the common carotid by a sharp retractor and carefully loosened by the use of dull-pointed, short, curved scissors, cutting toward the capsule and never away from it. If this rule is adhered to and the use of the scalpel be confined to the skin incision and preliminary exposure of the glands, the operation becomes a simple one. The sterno-mastoid and skin must be well retracted so that the operator is never cutting that which he does not see. After the glands have been removed from the front and superficial to the muscle, the posterior edge of the latter is exposed and pulled forward, so that the internal jugular vein and entire posterior triangle are exposed. By similar dissection the glands can be removed *en masse* from the internal jugular, to which they are usually firmly adherent, without any danger. The spinal accessory emerges from the sterno-mastoid at the middle of its posterior border and enters the trapezius at the level of the seventh cervi-

cal vertebra. It is easily wounded, especially if it is firmly adherent to and embedded in a mass of glands, unless its position be remembered.

A little farther down on both sides of the neck it is possible to injure the pleura and subclavian vessels, but scarcely probable, if even ordinary care be taken. The same holds true, on the left side, for the thoracic duct which has been severed about twenty times, causing only a disagreeable discharge of lymph from the wound, which persisted for some time. If abscesses are present, they should be thoroughly curetted, and the walls touched with pure carbolic acid, followed by alcohol. The writer is in the habit of packing every corner of the wound firmly with iodoform gauze, which is permitted to project through the lower angle of the wound. The remainder of the skin incision is sutured with fine silk-worm gut and a continuous horsehair suture. The gauze is gradually removed after forty-eight hours. The scar, if care has been taken to obtain accurate approximation, is very small, and in three to four weeks the wound is firmly healed.

ORIGINAL TRANSLATIONS.

THE TRANSMISSION OF BOVINE TUBERCULOSIS TO MAN.*

BY ROBERT KOCH,

Director of the Institute for Infectious Diseases in Berlin.

In the following communication I shall keep strictly to the subject appointed for discussion, "the transference of bovine tuberculosis to man," and not follow the example of most of the preceding speakers who have occupied themselves with the reverse question, the transference of human tuberculosis to cattle. It would lead me too far if I debated this question here also, but I reserve to myself the right of entering more fully into it when, in the near future, I publish my further investigations on human and cattle tuberculosis.

On the whole I completely agree with what the Chairman has said. I too have been specially struck by the fact that the statistics of primary intestinal tuberculosis collected up to now are somewhat uncertain, and too much affected by contradictions to be turned to good account as evidence to determine the point at issue.

This form of tuberculosis is said to be specially frequent in England, according to the accounts of Woodhead,¹ Still,² and Shennan.³ But English returns are not wanting according to which primary intestinal tuberculosis in that country is said to occur less frequently (according to Carr⁴ only five times in 53 tuberculous children under 2 years) or still more rarely according to Koutts.⁵

In America out of 369 children in New York, 5 (1.4 per cent.) were found with primary intestinal tuberculosis according to Bovaird.⁶ In Boston, on the contrary, according to Councilman,⁷ there were 37.1 per cent.

In Germany, as far as I have been able to find statements on the subject in literature, and as far as my personal inquiries have reached, all authors have expressed the opinion that primary intestinal tuberculosis is with us a very rare occurrence. The only exception to this is at Kiel, where Heller has found 37.8 per cent. of primary intestinal tuberculosis at necropsies of tuberculous children.

I can contribute the following facts to the critical examination of these circumstances. A year and a quarter ago the Minister of Education

*An address delivered at the International Conference on Tuberculosis, in Berlin. Translation revised from the *British Medical Journal*, Dec. 20, 1902.

issued invitations at my request to the heads of the university clinics in Prussia to render accessible to me such cases of primary intestinal tuberculosis as have incurred the disease ostensibly through the use of the milk of cows suffering from *Perlsucht*. The same invitation was issued eight months ago to the directors of the Institutes of Pathological Anatomy of the Prussian Universities with regard to cases of primary tuberculosis of the intestines, the mesenteric glands, and the peritoneum, so far as the onset of the illness might be traced to the use of food from cattle affected with *Perlsucht*, from the histories of the disease or special facts ascertained. Herr Heller in Kiel received a special invitation of this kind.

But up to now only a single announcement has reached me either from the hospitals or from the Institutes of Pathological Anatomy, so I think I must conclude that within this time at the Prussian Universities no case of primary intestinal tuberculosis has come under observation which can be referred to the use of food from cattle affected with *Perlsucht*. Still, before this decree Virchow placed at my disposal a case of primary intestinal tuberculosis, in reference to which he expressly noted that cases of the kind did not often occur—perhaps three or four times a year—at his institute. It so happens that this is the same case—as I note, by the way—which Herr M. Wolff has reported on in the course of the discussion. He stated that he had produced *Perlsucht* in a cow with tuberculous material which he had obtained from it. In my investigation of this case I have arrived at an exactly opposite result, for the pure culture of tubercle bacilli obtained from it showed itself quite non-virulent for cattle. I cannot enter here into the reasons why Herr M. Wolff and I arrived at such contradictory results. I must reserve the discussion of these for another occasion.

The striking contradictions already mentioned in the statistical data of primary intestinal tuberculosis must naturally have some explanation. Differences of locality do not appear to lie at the root of the matter; at least, I have been able to make out nothing of the kind with regard to Kiel and the rest of Germany. There remains, then, scarcely anything else in which to seek the explanation but the uncertainty of subjective opinion as to what is understood by primary intestinal tuberculosis, so that many still apply this description to cases which others will not allow to pass as such. But we shall scarcely arrive at facts for consideration, acknowledged on all hands as reliable, till we have come to agreement on this point.

Less full of contradictions are the assertions concerning observations of skin infection in veterinary surgeons, butchers and slaughter-house

employees related by the Chairman. There already exist a fair number of communications as to occurrences of this kind. I have myself had many opportunities of examining such cases.

They all have this in common, that after wounds on the hands or arms which have occurred while cutting up an animal affected with *Perlsucht*, wart-like formations—the so-called tuberculosis verrucosa cutis—develop. If the wound extends to a tendon in rare cases a tuberculous inflammation of the tendon sheath may occur. In isolated cases the process seems to have attacked the nearest lymphatic glands as well, but to a very slight extent. In all other respects the disease remains localized, does not lead to a tuberculosis of internal organs, and runs its course as an insignificant skin malady which often gets well of itself, as slaughter-house employees have often assured me.

Up till now only in one case has such a lesion ever been held to have led to a general infection. This is the case recorded by Pfeiffer of a veterinary surgeon in whom tuberculosis of the lungs developed fifteen months after a wound of the finger, leading to death in the following eighteen months. At the necropsy, however, the axillary glands proved to be free from tuberculosis, and we must conclude from this that no connection existed between the wound of the finger and the tuberculous infiltration of the lungs. The question was only one of a casual coincidence between a localized lesion from *Perlsucht* infection—if such infection existed at all, and even this is not proved—which remained local, and an infection of the lungs from another source. Bearing in mind the extraordinary frequency of primary tuberculosis of the lungs, a coincidence such as this with tuberculosis verrucosa cutis must occur incidentally now and then.

A new case of the same kind almost insinuated itself into the literature of the subject a short time ago. A veterinary surgeon in Berlin is said to have injured his index finger at the necropsy of a cow affected with *Perlsucht*, to have become phthisical in consequence of this, and to have died of hemoptysis. Inquiries instituted at once elicited that the man in question came of a tuberculous family, and before wounding his finger showed undoubted signs of tuberculosis of the lungs.

Again, a case communicated by Hartzell⁸ cannot stand even the mildest criticism. A laborer had received a wound on the back of his hand while repairing a cattle truck. Warts subsequently developed, and he died a year later of tuberculosis of the lungs. Every proof of connection between the two affections is wanting here. It is not even stated whether a necropsy was made. Still weaker is the statement contained in the

same work by Ravenel that the death of Mr. W., of the Royal Veterinary College of Edinburg, was attributed to an infection which he contracted at the necropsy of a cow affected with *Perlsucht*.

With the best will in the world nothing can be done with such defective information towards clearing up the question considered here. It is better to leave it entirely aside and look out for really conclusive observations.

Baumgarten's communication concerning the cancer patients inoculated at Königsberg with virulent *Perlsucht* bacilli, I consider, on the contrary, very significant. It is a question of an experiment under trustworthy observation in all its bearings and throughout its whole course; and since it is recognized as proved that no antagonism exists between cancer and tubercle, the negative result of this investigation can only point to the fact that the *Perlsucht* culture in question possessed no virulence for man in subcutaneous injections.

In all investigations which aim at solving the question of the transference of bovine tuberculosis to man, through statistics of primary intestinal tuberculosis and observations on skin infection in man, we must clearly keep in mind that the evidence with which we have to deal is always indirect. Because of the cases on which statistics are based we can at most know that they are genuine cases of primary intestinal tuberculosis, but, we cannot know that they really depend on *Perlsucht* infection, it is much more likely that they are the result of infection from human sources, with which, on account of its extraordinary frequency, we have to reckon in every single case.

Even the occurrence of a *Perlsucht* infection, which remains local, as a result of a skin wound, does not in any way prove that *Perlsucht* bacilli are also capable of infecting the uninjured intestinal mucous membrane, or if they are able to pass through it without leaving any traces behind, that they render the mesenteric glands tuberculous, and from thence bring about a general infection of the body with its well known and justly feared consequences.

On the other hand, we would expect that if tuberculous infection through partaking of tuberculous meat and milk really occurs as frequently as is asserted, direct observation must make this obvious.

This side of the question has, in my opinion, been much too little regarded up to the present, and it is very necessary that we should turn our attention once again in this direction. Analogous considerations are not wanting in this connection. There are several other infectious diseases

conveyed to man by feeding on meat and milk, and their behavior may be very instructive to us in relation to tuberculosis.

I remind you in this connection of the so-called cases of meat poisoning which have been largely caused by a typhoid-like bacillus, and also the illnesses resulting from the use of the flesh of animals which had suffered from splenic fever. Milk, too, may contain typhoid bacilli, as has been so frequently observed in recent times, and these give rise to an outbreak of enteric fever.

It is extraordinarily characteristic of all these outbreaks that they do not occur as isolated illnesses, but in groups and often in epidemics. This could scarcely be otherwise, for the milk of a cow, the flesh of a sick animal is practically always partaken of by several, and often by a great many people at the same time, who will be infected and fall ill, certainly not as a whole, but in a larger or smaller percentage.

Not only is attention directed to the infection which has taken place, and to its common cause, by the number of cases of illness of the same kind, but incontestable evidence arises thus that the food in question must have contained the infectious material. Under such conditions no statistics and no experiments on animals are required; the observation itself yields us direct proof of the occurrence of the illness from the use of infected food.

A tuberculous infection must also take shape in the same way if tubercle bacilli which are virulent for man are found in meat or milk. Here, too, a certain percentage of people who have taken the infected food must fall ill, and a group of illnesses must occur.

Of course the circumstances will differ to some extent in the case of tubercle and that of typhoid; for, owing to the much longer incubation period of tuberculosis, the illnesses will not arise so soon after infection or be comprised within so short a space of time. But, on the other hand, tuberculous infection is favored by the fact that the ingestion of tubercle bacilli is repeated many times, and extended over a long period among those people who are given to the use of food from animals affected with *Perlsucht*, so that the probability of the outbreak of infection must be essentially raised.

Everything, then, combines to show that tuberculosis also—if as a fact it can be produced by the flesh and milk of animals suffering from *Perlsucht*—must occur in groups, and it is only a question whether this has not for a long time been observed and described.

B. Fraenkel has since drawn my attention to the fact that he expressed a similar opinion in his work on tuberculosis in the *Gerhardt*

Manual of Diseases of Children before the discovery of the tubercle bacillus. He at that time maintained the opinion that tuberculosis could not be conveyed by the milk of cows suffering from *Perlsucht*, and gave as his reason that he had never observed that several children in one family suffered at the same time from tuberculosis, which would necessarily be the case if the common milk-can furnished the cause.⁹

Let us next examine the literature of the subject for communications concerning illnesses following the ingestion of infected meat.

But I should like to draw attention beforehand to the fact that probably not only meat which is free from tubercle or has been boiled or well roasted, is eaten as is usually supposed. On the contrary, an expert on meat inspection, Ostertag,¹⁰ says of this: "Day by day an uncounted number of tuberculous organs come into the market and are consumed." They are mostly made into sausage. Only a short time ago I had to express an opinion as an expert witness in legal proceedings about a case in which meat, infected with *Perlsucht*, which had been delivered without his knowledge at the business house of a court meat purveyor, was only by chance prevented from being made into sausage. Although, then, no doubt can exist that a short time ago, from deficient meat inspection, much meat infected with *Perlsucht* reached the market and was often enough eaten, yet in the whole literature of the subject not a single observation of groups of illness or epidemics, in consequence of the ingestion of meat infected with *Perlsucht*, can be found. But still more, not even once is an isolated case of illness described, and reports on damage to health from meat infected with *Perlsucht* are equally wanting.

On the contrary, facts are recorded by several authors which prove the opposite. According to Bollinger,¹¹ a collective investigation instituted by the order of the Bavarian Government in 1879 yielded a number of isolated observations which speak for the harmlessness of the flesh of tuberculous animals. Many families, even whole villages, were found which habitually consumed tuberculous meat without tuberculosis occurring more frequently among them than elsewhere. Göring¹² and Schottelius¹³ have had quite similar experiences.

In consequence of this a very lenient opinion prevails with regard to the danger of meat infected by *Perlsucht*. At the Congresses of Tuberculosis in Paris in 1885 and 1891 the complete exclusion of the flesh of tuberculous animals as a class was decided on. But at the Congress of 1893 and that of 1898 a more rational opinion was arrived at, and the sale of the flesh of animals in which tuberculosis was only local was considered permissible. At the Seventh International Congress on Hygiene in London the

complete exclusion of tuberculous meat was unanimously set aside. Ostertag, an energetic champion of the identity of bovine and human tuberculosis, says, in his handbook of meat inspection (1899): "In face of the rare occurrence of primary intestinal tuberculosis in man and the wide dissemination of bovine tuberculosis, only a very slight risk to the health of mankind can be empirically attributed to the flesh of these animals."

The same standpoint is taken by the highest authorities in Prussia. From a circular decree from the Ministers of the Interior, of Agriculture, of Medical Affairs, and of Commerce and Trade, dated March 26th, 1892, I quote the following:

Since attempts on a large scale and carried on for some years at the Berlin Veterinary College and several Prussian universities to produce tuberculosis in animals by feeding them on the flesh of other animals affected with *Perlsucht* have given an essentially negative result (opinions of the scientific deputation for the Faculty of Medicine from December 1st, 1886), the transference of tuberculosis from the use of meat which is even infected with nodules of pearl disease is not proven, and the flesh of well-nourished beasts cannot be considered as a rule less valuable, even if (tuberculosis) illness exists, nor can its sale be placed under special police supervision.

From all this we gather that proof of the danger of meat of animals affected with *Perlsucht* is completely wanting; it is, as the Ministerial decree expressed it, "not proven."

While no one will deny that the *Perlsucht* bacilli in meat are identical with those occurring in milk, an inexplicable contradiction exists in the fact that far stricter views have prevailed recently against the milk of tuberculous beasts than against tuberculous meat.

Now, what is the status in regard to the direct proof of the danger from the milk of animals suffering from *Perlsucht*? *Perlsucht* bacilli contained in milk also come into the market to a considerable extent, and are taken in a living condition much more frequently than is usually accepted. Next, it should be observed that 1 to 2 per cent. of all milch cows suffer from tuberculosis of the udder, and without exception yield milk containing more or fewer bacilli. But tuberculosis of the udder is not of such a character that it can be recognized as such from its earliest onset. If one watches the disease and allows a tolerably certain diagnosis to become possible, it will have existed for weeks and even months, and the milk with its *Perlsucht* bacilli, will have been drunk. Such milk will scarcely ever be used by a single individual. As a rule it will be mixed with the milk of several other animals from the same herd and be ingested by a

still larger number of people. If the milk reaches a central dairy it may be divided amongst hundreds of consumers.

In regard to the last event, I cannot share the view of Nocard, that milk may become less infectious from dilution and the *Perlsucht* bacilli quite inert. If it were a question of a poison in solution this assumption would be justifiable. But here we have to do with microörganisms which can only be separated, not diluted, but then come in contact with all the more people, and—if they are virulent, for them—become all the more dangerous.

Now people usually rely on the fact that *Perlsucht* bacilli are killed by boiling the milk, but in this respect they make a great mistake. To be sure, if in a laboratory experiment milk is brought to the boiling point, all the *Perlsucht* bacilli are destroyed. But in the household method of boiling milk they remain alive. Prof. Beck¹¹ has at my instigation, instituted numerous and important investigations on this point at the Institute for Infectious Diseases, and has found that tubercle bacilli are not killed by a single, short boiling up of milk in wide-mouthed vessels—the treatment milk usually receives in a household. To attain this object, uniform boiling for several minutes is necessary, and this the housewife will not condescend to do because the milk easily boils over or gets burnt. If, therefore, anyone asserts that he imbibes no living *Perlsucht* bacilli because he only drinks boiled milk he has still to produce evidence that the milk taken by him is always kept boiling for several minutes.

Again, one cannot absolutely rely on the sterilizing apparatus used in the larger dairies. As long as it is used according to regulations and carefully superintended, most apparatus of this kind may certainly fulfil their object, but as soon as the necessary care is once temporarily wanting, the infectious material perchance present slips uninjured through it, as the numerous typhoid epidemics which have originated from such dairies show.

One other point I might draw attention to, one which almost always remains unnoticed in discussions on milk infected with *Perlsucht* bacilli. We are not only concerned with the milk, but also with the products which are made from it, especially with butter, which evidently very frequently contains living *Perlsucht* bacilli. It has frequently happened to me that persons who vehemently protest that they have only used boiled milk for years because of the danger of *Perlsucht*, when asked what they did about the butter, confessed that it had never entered their heads, that, in the natural order of things, this should be sterilized too.

Under such circumstances I believe I am justified in asserting that certainly almost everyone in the course of his life has more or less often, and in considerable numbers, ingested living *Perlsucht* bacilli. If *Perlsucht* bacilli are really dangerous to man we might logically expect that instances would have been very frequently observed and described of injury to health which has been unquestionably caused by milk infected with bovine bacilli. I have looked at the literature bearing on the subject, and believe I can assert that nothing essential has escaped me. Instead of the countless cases on which we ought to reckon I have been able to find among them all only two groups of illnesses and 28 isolated cases of illness, and we must, moreover, consider whether as pieces of evidence they are really free from objection.

Thus the next thing to discuss is the celebrated and constantly quoted case of Ollivier, which he communicated to the *Academie de Medicine* on February 24th, 1891. In a girls' school in the course of a few years 13 pupils sickened with tuberculosis, 6 of whom died. In several cases the intestinal canal seemed the starting point. When the cause was sought it appeared that a cow which had been kept for some years in the establishment of the school suffered from tuberculosis of the udder, and that the milk had been drunk by the boarders. This indeed looked just as if a group of illnesses had occurred in consequence of the use of milk infected with *Perlsucht* bacilli, and that here a case of *Perlsucht* infection was found which was free from objection. Ollivier was of this opinion, and so have been all those who up to the present time have turned this case to good account as a classical example of infection through milk containing *Perlsucht* bacilli. Yet the case is by no means so free from objection as has been maintained, for, apart from the consideration that apparently only one necropsy was made, and that the diagnosis of alleged intestinal tuberculosis is somewhat uncertain, people have contented themselves with excluding heredity as a cause from another quarter which comes under consideration. A direct infection from one person to another has not been publicly brought under consideration at all, and yet the course of this little epidemic of tuberculosis would have been exactly the same if one of the boarders or a pupil had suffered from tuberculosis of the lungs, and infected a number of her companions through the sputum. Something of the kind has often occurred, and its possibility would have to be considered among all the circumstances. But, even apart from this consideration, the alleged classical case vanishes away, and even proves the reverse, as the result of a second communication by Ollivier, which he found himself obliged to make at the next session of the Academy, in

consequence of better information. He actually had to declare that he was mistaken; that the milk from the cow in question was not drunk by the boarders, but by the teaching staff and the domestic servants of the establishment. Among those persons who had regularly partaken of the suspected milk not a single case of tuberculosis had occurred.

If, in spite of this correction, Ollivier's case is still used by the defenders of the identity of human and bovine tuberculosis as a proof, they show in what a one-sided and uncritical way they go to work to procure their evidence.

I come now to the second example of a group of illnesses. This was published by Hüls in the *Muenchener medicinische Wochenschrift* a few months ago. In a miller's family of nine persons who are alleged to have fed for years on the milk, butter, and meat of tuberculous animals, and in other respects are said to have had no opportunity of infection, seven members died of consumption. In this case we need only pay attention to the succession of the fatal cases to see at once that the connection is quite different from the one accepted by Hüls. First the mother sickened, but recovered again after some months. In the following year the youngest child sickened and died. In the same year a son, aged 18 years, became ill and died. A year later followed a son, aged 23 years. In the next year the mother got ill again and died; then followed a girl of 16, then the father, and, lastly, a third son. That, among the relations of the illness to the family here indicated, contiguity, the dwelling together of the sick and the healthy, and so the transference from one to another should be excluded, is to me incredible. Every expert in infectious diseases will be convinced without any further evidence that there was in this case a continuous chain of contact infections and not a group of illnesses arising from infected food. In order to be able to accept the last as the origin the illnesses must have ensued in the course of six months or a year at least; they could not, as was the case here, be protracted over a series of years. So this case of a group of illnesses also comes to nothing, and there only remain the 28 cases of isolated illnesses.

These do not merit any great confidence in and for themselves. Should we allow a single typhoid case, in which the use of suspected milk could be proved, to pass without further investigation? We certainly should not. Notwithstanding, I neither can nor will contest the possibility that single cases may occur. But in order to be convincing they must fulfil certain conditions. These conditions are as follows:

1. Certain proof of tubercle in general, and, where possible the primary focus must be supplied. In adults we must, therefore, require

the existence of unassailable clinical symptoms, and a necropsy when these are not present. In children the clinical symptoms are much too uncertain, and so a necropsy is always requisite with them.

2. Other sources of infection must be excluded with certainty. The assurance that the person in question comes of a healthy family is under no circumstances sufficient. There are numerous other possibilities of infection either inside or outside the family which come up for consideration. In this connection I can only agree with the Chairman who has drawn attention to the researches of Preisich and Schütz, and of Dieudonné on the occurrence of tubercle bacilli round the nails of children, and thus to a source of infection in children well worthy of heed.

3. In each case of alleged infection from milk infected with *Perlsucht* bacilli the condition of the rest of the people who have taken the same milk should be borne in mind. These fellow-consumers form to a certain extent a control experiment, and if of the numerous people who have drunk the suspected milk only a single one sickens, this weighs decidedly against the belief that this one person was infected by the common food. With typhoid, too, if only one of all the people who had drunk the same milk contracted typhoid, we should on this ground alone immediately relinquish the suspicion that it could depend on a milk infection.

4. The source of the milk should be attended to. Since in recent years it has become more and more evident that milk containing tubercle bacilli is yielded only by such cows as suffer from tuberculosis of the udders, the general statement that someone has drunk milk from a cow suffering from *Perlsucht* no longer suffices to prove to us that *Perlsucht* bacilli have really reached his digestive organs. A man can certainly ingest milk from a cow suffering from *Perlsucht* without coming into contact with *Perlsucht* bacilli through it. It must be milk from a cow with tuberculosis of the udder, and therefore a statement on this subject should not be wanting in a report on milk infection if it is said to be complete.

If I now examine in this way the 28 single cases I have collected from literature and see how far they correspond to the conditions just laid down, I come to the following results:

1. In only 10 cases is it stated that a necropsy took place, and only 7 of these are said to have had intestinal tuberculosis.

2. Only in 3 cases is it asserted that the milk came from a cow with tuberculous udder.

3. In not a single one are other possibilities of infection excluded with certainty. As a rule only absence of heredity is alleged, though we know that just this plays a very subordinate part if any.

4. In no case is anything stated about the condition of other people concerned.

The insufficiency of these data has not even entirely escaped those who use them. Thus Ravenel says:¹⁵ "The number of cases in which infection can be traced back to the use of tuberculous milk is not great (it would be more correct to say, 'is, contrary to the expectation, small'), and almost all are open to the objection that all other sources of infection cannot be completely excluded." And in the report of a Committee of the American Public Health Association,¹⁶ which is distinguished in other respects by the observance of a strikingly biased point of view, it is confessed that we cannot tell from the recorded cases whether the illness was caused by the *Perlsucht* bacillus. But in spite of this confession, the collected cases are treated as if they were incontrovertibly proved.

It therefore appears to me necessary to mention shortly some of these cases, and particularly those among them which are regarded as quite certain and have attained thus to a degree of celebrity.

I begin with the case of Gosse which Nocard¹⁷ has recorded. Dr. Gosse, a Genevan doctor, regularly resorted with his family to a farm on Sundays where his granddaughter, 17 years old, drank by preference, milk straight from the cow. The young girl sickened, and after a long illness died of intestinal tuberculosis as the necropsy showed. On this an investigation was set on foot, which showed that of the five cows on the farm four were tuberculous and two of the latter actually suffered from tuberculosis of the udder. This fact was considered sufficient to base on it the assertion that the illness and death of the young girl must have been caused by milk infected with *Perlsucht* bacilli. The possibility of the infection arising in any other way is nowhere discussed, and yet during her permanent residence in town she must undoubtedly have had sufficient opportunity of being infected from some other quarter. We must further ask, what became of those people who drank the rest of the milk which came from the farm. The inhabitants of the farm had undoubtedly done so. Have any of them become ill? Had this been the case we should have been made acquainted with it at once. As this has not happened we must consider no one else became ill, and we are further urged to the logical conclusion that the milk in question was not injurious to health, and cannot be blamed for the illness of Dr. Gosse's granddaughter. Nocard, who introduced the case into the literature of *Perlsucht*, was of the opinion that it had almost the value of an experiment. I do not believe that this distinguished expert in tuberculosis, who knows quite well with how many precautions and how carefully experiments on

tuberculosis must be carried on, in order to satisfy our present day scientific demands, would still maintain the opinion. Still less sound than the case just mentioned is the one which Dr. Stang observed in Amorbach. This is described by Bollinger¹⁸. A 5-year old boy suffered from dropsy and died with the symptoms of consumption. At the necropsy, tuberculosis of the lymphatic glands of the abdomen and of the serous membranes and lungs was found. With regard to the etiology of the case, it was elicited that no tubercle had occurred in the family for two generations, and that the boy for a year had drunk the milk of a cow affected with *Perlsucht*. This case too, Bollinger says, may be compared to an experiment, but besides the same critical considerations which had to be raised against the preceding case, there is this in addition, that we cannot ascertain whether the cow suffered from tuberculosis of the udder. Furthermore, the boy had tuberculosis of the lungs, as well as of the mesenteric glands and peritoneum, and it would have to be fairly established that this was not the primary lesion as is so frequently the case.

In the often-quoted case contributed by Johne,¹⁹ we only learn that a child, 2½ years old, whose state of nutrition had been enfeebled by measles and bronchial catarrh, died of miliary tuberculosis of the brain. He had been fed with milk from a cow infected with *Perlsucht*. Whether a necropsy was made, whether other possibilities of infection were excluded, whether the cow suffered from tuberculosis of the udder, whether other people who had drunk the same milk had sickened, is not stated.

According to Uffelmann²⁰ a child died after partaking of the unboiled milk of a sick cow, of tubercles which developed in the subcutaneous tissues. Neither in the case of the child nor the cow was a necropsy made. Uffelmann himself assigns no evidential value to this case, yet in spite of this it is regularly brought forward in literature when the point at issue is to prove the danger of the milk of cows suffering from *Perlsucht* from cases occurring in practice.

Some reporters²¹ have even said that children while they took milk from a cow suffering from *Perlsucht* were sickly, suffered from eruptions and coughed, but soon recovered again if the milk from healthy cows was given to them. Such cases naturally prove the opposite from what they are meant to prove, namely, that milk infected with *Perlsucht* bacilli was drunk by children for a long time without their becoming tuberculous.

The rest of the cases are like those just enumerated.

We come then to the conclusion that not one single observation free from objection can be cited of the injurious influence of milk infected with *Perlsucht* bacilli any more than for the harmfulness of meat affected in the

same way, though numerous people continually expose themselves to the supposed danger.

But for milk infected with *Perlsucht*, bacilli as with meat, there exist observations of the fact that people have for a long time drunk it with no ill results. To be sure, the statements on this point are not numerous, evidently because it was much more interesting to look for infection, while none bothered themselves about the absence of infection.

Yet it would be easy in a short time to collect serviceable material. In the country where relations are clear it would only be necessary to have cases of genuine udder tuberculosis, and to ascertain how long the illness had existed in the animals; what people, especially children, had partaken of the milk and the butter made from it; whether, and how, the milk was boiled; and whether the persons concerned had fallen ill of tuberculosis in the course of one to two years; and, of course, the form which it took.

Very numerous letters have reached me in the course of the last year from people who have told me that they themselves or their relatives had drunk unboiled milk of cattle affected with *Perlsucht* for a longer or shorter time, and had remained healthy. As it is not possible to examine these cases as to their accuracy, I will not enter upon the matter; but I should like to request the International Committee to bring its influence to bear, so that instead of the quite unservicable material now existing, reliable observations should be collected, including, of course:

1. Cases of alleged infection from ingesting milk infected with *Perlsucht* bacilli, having regard to the conditions advanced by me (necropsy, exclusion of other sources of infection, condition of other people who have drunk the same milk, proof of tuberculous udders).
2. Cases of absence of infection after partaking of milk infected with *Perlsucht* bacilli, likewise under the control of the required conditions (proof of udder tuberculosis, sufficiently long observation of the people, statement as to whether and how the milk was boiled).

Provisionally we can only say that the injurious effects of milk infected with *Perlsucht* bacilli and its products are not proven. What these facts signify in relation to the immensely frequent opportunities of infection, I leave to the individual judgment.

Obviously this opinion holds good only in the case of mankind. It is a matter for agricultural and veterinary science to determine how far milk infected with *Perlsucht* bacilli is detrimental to cattle, and what measures should be taken to combat the danger which perhaps exists. Measures concerning meat and milk infected with *Perlsucht* bacilli which are meant

to combat human tuberculosis cannot be well founded at the present time. Further, such measures would be very costly, because of the compensation which would have to be paid for animals judicially seized, and on account of the immense quantity of milk which would have to be inspected. It is, however, decidedly more fitting not to lay out a sum of this kind for something which is far from being established, but to apply it rather to such measures as must with certainty lead to a decline of human tuberculosis.

In this connection I can only repeat what I said in my London address: The fight with tuberculosis must not be fought on wrong lines if it is to have a real result. It must aim at shutting off the chief, indeed we may say almost the only, source of infection. This is those consumptives who in consequence of the unfavorable conditions under which they live, or because they obstinately set aside the simplest rules for the prevention of infection, are a danger to their companions. In some way or other we must look after these sick people, either by procuring for them more favorable conditions, for example, as regards dwelling places, or by so sheltering them in suitable institutions that they cease to be a danger to their neighbours.

After the experiences we have had of other infectious diseases, we must come to the conclusion that in no other way can anything be attained, and therefore I should like urgently to advise that for the future this task should be kept to the fore in the battle against tuberculosis until it has been accomplished.

¹ *Lancet*, July 14th, 1888.

² *BRITISH MEDICAL JOURNAL*, August 19th, 1899.

³ *Scottish Medical and Surgical Journal*, September, October, 1901.

⁴ *BRITISH MEDICAL JOURNAL*, August 19th, 1899.

⁵ Coutts, *BRITISH MEDICAL JOURNAL*, August 10th, 1901.

⁶ Bovaird, *Archives of Pediatrics*, vol. xviii, No. 12, 1901.

⁷ Councilman, Mallory, and Pearce, *Diphtheria*, Boston, 1901.

⁸ Ravenel, *The Intercommunicability of Human and Bovine Tuberculosis*, 1902, p. 18.

⁹ Compare B. Fraenkel, *Berl. klin. Woch.*, 1901, No. 33.

¹⁰ *Handbuch der Fleischschau*, 1899, p. 646.

¹¹ Ostertag, loc. cit., p. 646; Bollinger, *Deutsche Zeitschr. f. Tiermedizin*, Bd. VI, p. 242, Bd. ii, pp. 138 and 279.

¹² *Deutsche Zeitschr. f. Tiermedizin*, Bd. VI, p. 142, ii. 290.

¹³ *Virchow's Archiv*, Bd. xci, p. 129.

¹⁴ *Deutsche Vierteljahrsschrift fuer oeffentliche Gesundheitspflege*, 1900, p. 430

¹⁵ Loc. cit.

¹⁶ *Relation of Bovine Tuberculosis to the Public Health*. Washington, 1901, p. 22; published by the U. S. Department of Agriculture.

¹⁷ *Les Tuberculosis Animals*, p. 124.

¹⁸ *Deut. Zeitschr. f. Tiermedizin*, Bd. ii, p. 281.

¹⁹ *Geschichte der Tuberculose*, Leipzig, 1883, p. 57.

²⁰ *Archiv f. Kinderheilkunde*, 1880, I, p. 414.

²¹ Göring, *Deut. Zeitschr. f. Tiermedizin*, Bd. vi, p. 142; Schoengen. *Aus der Dissert. von, Behrens, Ueber primäre Tuberk. Darm-Infektion des Menschen* Berlin, 1894.

ON THE LYMPHOCYTES OF TUBERCULOUS EXUDATIONS*

BY DR. ALFRED WOLFF, KÖNIGSBERG, PRUSSIA.

In No. 16 of the *Deutsche medicinische Wochenschrift*, 1902, there appeared an article on the ex- and transudations, derivation and significance of the so called lymphocytes of tuberculous exudates, value of cytodiagnosis, by Prof. Vincenzo Patella of Siena. As for a number of years I have studied the exudations, and have repeatedly reported the results of my investigations¹, I feel justified in making some comments on the article of this author, although he seems to have disregarded the German literature almost entirely.

He writes: "Hereby (owing to his deductions) the value of cytodiagnosis has been shaken in its foundations. The lymphocytes of exudations are not lymphocytes, but nuclear fragments of degenerated epithelia which originate through *Piknosi* (pyknosis probably meant) and karyorrhesis."

He calls them pseudolymphocytes. As proof that they are not genuine lymphocytes he adduces the fact that their size varies from 4-9 m.m. and more, that their chromatophile properties "often" stand in inverse ratio to their size. As further proof he adds that small particles, the result of cellular disintegration, are found in exudates, and finally he regards the question as settled, because he succeeded *in vitro* in changing, in a fresh tuberculous exudate, the finding from a chiefly endothelial to a pseudolymphocytical one. By this he thinks he has furnished indisputable proof that the so-called lymphocytes of tuberculous exudations depend upon pyknosis of the endothelia of the diseased mucous membranes.

It is probably merely a *lapsus calami* that he continually terms pleura and peritoneum mucous membranes. But the term *pseudolymphocyte* is employed repeatedly and intentionally; objection must be taken to this for the reason that an expression already employed for a well

* Translated for the *Journal of Tuberculosis* from the *Deutsche med. Woch.* No. 41, 1902.

¹ Transudate und Exudate, ihre Morphologie und Unterscheidung, *Zeitschrift f. klin. Med.*, XLII, 5-6; Untersuchungen über Pleurärgüsse, *Berliner klin. Woch.*, 1901, No. 34, 35; 1902, No. 6; Ueber Mastzellen in Exudaten, *Münchener med. Woch.*, 1902, No. 6. Gibt es eine aktive Lymphocytose? *Deutsche Ärzte-Zeitung*, 1901, No. 18.

characterized process by another author (Ehrlich), although perhaps wrongly, is again made use of for a new one without any reference to the earlier term.

Ehrlich understands by lymphocyte-formation a process, during which the nucleus breaks up into three, four or even more fragments. This segmentation, which appears to be caused by a simple tearing of the nucleus, is followed by a segmentation of the protoplasm which, according to the number of nuclei, causes the cell to divide into three or four small cells. These, in general, look very much like the lymphocytes and possess like them a great round nucleus and a narrow border of protoplasm.

Their mode of formation makes it easy to understand that the individual pseudolymphocytes vary in size. This is not the place to enumerate the reasons why we do not have to do here with lymphocytes. I refer the reader to the article which treats of this question in detail.¹ Of special importance, in this connection, is the chromo-chemical reaction of the protoplasm, particularly the presence of neutrophile granules. Thus the term pseudolymphocyte should be reserved at present for the above process. Nevertheless the use of this term leads to a possible explanation as to how the author may have observed the origination of lymphocytes from endothelia or epithelia.

It is as yet not generally known in Germany that the epithelia in exudations are large phagocytic cells, in the sense of Metschnikoff's view, that they take up cells which within their bodies undergo degeneration; most frequently they take up multinucleated cells and erythrocytes. We can accurately observe in the large phagocytic cells the process which Ehrlich has described as formation of pseudo-lymphocytes. The multinucleolated nucleus is broken up into 3, 4, 5, and even more round globules, and the final product may, indeed, easily be mistaken for a formation of lymphocytes, if we do not observe the initial pictures. The deception is increased by the behavior of the nucleus of the epithelial cell.

The karyorrhexis in the epithelial cells does not originate in their own nuclei, but in the nuclei of the cells included within them. The nucleus of the epithelial cell also undergoes important changes which I have elsewhere described² and which Dominici³ has found present in exactly the same way in large phagocytic cells of quite different origin. In short the changes are as follows:—

¹ Loc. cit. *Berliner klin. Woch.*, 1902, No. 6.

² *Berliner klin. Woch.*, 1902, No. 6.

³ *Archives de Médecine expérimentale*, Jan., 1902,

1. The nucleus leaves its central position and the cell assumes thereby characteristics which, according to Ehrlich, are like those of the large mononuclear leucocytes of the blood. Widal has also described the exudate-cells in like manner. At first sight there is apparently a great difference between the two kinds of cells, but in reality this is not the case. The epithelia have the function of the large phagocytes, according to Metschnikoff—Dominici the large mononuclear leucocytes represent the phagocytes of the blood. I have already spoken of their morphologic identity. Both types of cells can be traced embryologically to a common origin; according to Dominici's investigations the large phagocytes are derived from the endothelia of the vessels from which the mononucleated cells of the blood also have their origin.¹

2. The further changes consist in the vacuolization of the nucleus. Some stains, for example, the tri-acid, seem to indicate that the nucleus has disappeared. As the cellular inclusions, for instance the pseudo-lymphocytes, remain still clearly visible, it might easily appear as if the nucleus had changed to a pseudo-lymphocyte. But the nucleus is still present and fills the whole cell in the form of a fine network in the midst of which the three or four small nuclear bodies of these epithelia are situated. In order to demonstrate these changes a proper choice of staining fluid is essential, i. e., one uses best the reagents to which chromatin is most sensitive, as afforded by the method of Romanowsky.²

Pappenheim's pyronin-methylgreen mixture is also to be recommended. Stained with the first the nuclear network appears red-violet, the small nuclear bodies sky-blue, whereas with Pappenheim's method the latter appear red.

All the changes which have been described are vital and not, as Patella assumes, post-mortal. The cells do not leave the tissues because

¹ It can not, however, be denied that the evolution of the blood constitutes one of the most obscure chapters of embryology, in which the most diverse opinions stand in radical opposition. But it is not here the place to enter upon a consideration of the various theories and investigations from the standpoint of the more recent studies of the blood.

² Most useful appears to me to be Michaelis' modification of methylenazur, (cf. Virchow's *Archiv*, CLXVII, *Centralblatt f. Bakteriologie*, 1901, XXIX p. 763). The use of methylenazur has finally been deservedly appreciated by others also (Giemsa, *Centralblatt f. Bakteriologie*, 1902, XXXI, No. 9). Giemsa prefers methylenazur to the Romanowsky-Nocht solution, as being more constant in composition. A gramm of the most chemically pure methylenazur cost 15 marks.

As valuable as this preparation appears to be for the demonstration of the chromo-chemical descriptions of Michaelis, the solution of Michaelis for practical tinctorial purposes complies nevertheless with all necessary requirements, while its cost is almost nothing because in this solution the methylenazur remains almost unchanged.

In the *Centralblatt f. Bakteriologie* Michaelis emphasized, above all, the fact that the eosinazur produces the red reaction of chromatin, but he did not overlook (as Giemsa seems to believe) that numerous other cell portions also take the color, as appears in the detailed description of the method and its results for hæmatological purposes (Virchow's *Archiv*, CLXVII).

they are dead, but because they have vital functions to fulfill in the exudation. The cytolytic changes continue in them and represent metamorphoses which they undergo as a part of their function and for which analogies exist in glandular cells. In addition to this Heinz observed their amoeboid movements.

I may be permitted to direct attention to another source of error. The phagocytes and phagothelia do not take up only cells with which they come in contact, and which are normally present in the organism, but, as can easily be studied in the aleuronatexudations, foreign albuminous substances. As can best be seen with vital methylen blue staining, these epithelia are found full of small and large granules of albumin which may readily be mistaken for the nuclei of lymphocytes.

Patella does not give the technique of the staining method with which he obtained his results; only once he mentions haematin; of his material he recommends mostly peritoneal fluids. As far as I am aware, no one has, as yet, recognized lymphocytes in peritoneal fluid as characteristic of tuberculous processes, and I have but recently stated in a collective review¹ that our knowledge of the morphologic relations of peritoneal effusions is still entirely insufficient to arrive at any conclusions whatever for diagnostic purposes. So it appears quite comprehensible that Patella in a case of ascites with pseudoleukaemia excluded the diagnosis of tuberculous peritonitis, although the lymphocytes in the exudation outnumbered the endothelia.

Considerable astonishment must be caused by his finding of numerous endothelia in tuberculous effusions, especially in the initial stages, a discovery which contradicts the statements of all other authors who have devoted especial attention to this point. According to Widal and Ravaut no endo- or epithelia whatever are found in tuberculous effusions and according to my researches they are found but very sparsely. It is hardly comprehensible that investigators like Widal and Ravaut and all their French followers should have overlooked numerous epithelia. It would therefore, be of great interest to ascertain upon what grounds Patella determined the tuberculous nature of the effusions. This question is of importance because as claimed elsewhere², if cytodiagnosis is not available for this purpose the diagnosis during life will often be impossible.

Having, in the foregoing remarks, only indirectly defended the lymphocytic nature of cells of exudations, by referring to the changes which could apparently have been brought forward as evidence for the assump-

¹ *Fortschritte der Med.*, April, 1902.

² *Berliner klin. Woch.*, 1901, No. 34.

tion that the lymphocytes in exudations are developed from epithelia, I will now further consider the grounds which I think justify me in believing that the cells under discussion may be considered as lymphocytes.

The cells of the exudations present morphologically exactly the same pictures as the lymphocytes, i. e., they are characterized by a round nucleus, surrounded by a narrow protoplasmic ring, which is still more basophile than the nucleus. The pseudo-lymphocytes of Ehrlich, which possess a certain morphologic similarity to the lymphocytes, can already be differentiated according to this definition, because their protoplasm is not more basophile than the nucleus and the protoplasm does not usually show the narrow margin. The structure of the lymphocytes is, therefore, so peculiar and so well characterized with reference to stains that one can hardly believe a process of degeneration capable of reproducing the same picture.

We are, however, in the fortunate position that we are able to recognize by means of micro-chemical staining reactions the identity of a cell with a lymphocyte, so that we are not obliged to rely on a purely morphologic picture, above all not in the study of transition forms, which are combined differently by every observer, as is especially shown by the study of the finer morphology of the elements of the bone-marrow. Although I do not agree with Pappenheim that the red staining of the protoplasm with the pryonin-methylgreen mixture is a specific lymphocyte reaction, because I have observed the red staining in myelocytes, epithelia and other cells, the intensity of the stain is, however, such a significant differential diagnostic criterion that we are thereby easily enabled to distinguish a lymphocyte from another cell.

Besides, Romanowsky's method is of great importance for these investigations. We have already described the mode of demonstrating with it the nuclear network of epithelia in exudations. At the same time this method may be employed advantageously for the identification of the lymphocytes in exudations, since it depicts them as surrounded by a sky-blue border. The granules described by L. Michaelis and by me in Virchow's *Archiv*, vol. 167, I have not yet been able to demonstrate in exudations.

It must not be concealed that these color reactions do not occur with the same certainty in exudation-cells as for instance in a blood preparation, and we must never forget that in exudations we are dealing with cells which, compared with blood cells, have undergone certain changes. But in a great many the reactions are successful and very distinct. The defenders of the lymphocytic nature of the cells under discussion are in

the favorable position that victory lies with them, if they adduce positive proof that these cells are not products of degeneration of epithelia, but are real lymphocytes.

In conclusion I may be allowed to ask the question: If lymphocytes are derived from epithelia through degeneration, why are no lymphocytes found in exudations which, according to universal opinion, contain numerous epithelia, as for instance the metapneumonic?

The examination of exudates, especially for scientific purposes, is a particularly difficult problem, because all the cells of the exudate are changed from the normal. Only the combined employment of all available methods, among which I desire to emphasize more particularly the advantages derivable from vital staining, will lead to reliable results.

I believe that in accordance with the foregoing we are justified in continuing to regard the cells as lymphocytes until Patella shall demonstrate new and important facts in the physio-pathology of mucous membranes by the chemical and experimental examinations avowed by him as forthcoming, and by which he will contribute new and more convincing material for his views.

ON INTERRUPTED RESPIRATION*

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By interrupted respiration we understand respiration occurring in jerks. This can be voluntarily produced by means of puffy inspiration or expiration. More or less involuntary is that form of interrupted inspiration seen in persons who are weeping or are under great mental excitement. Inspiration may be rapidly interrupted in the act of differentiating various odors (sniffing). Deep inspiration following prolonged superficial breathing is frequently interrupted.

Furthermore in persons shivering with cold the respiration is of a vibrating character, which is due presumably to muscular action, just as is the interrupted respiration described by Wintrich as occurring during rigors of various fevers, and the interruption observed by him in elderly people. Another form of interrupted respiration mentioned by Sahli is at times noticeable when the muscles of respiration do not act in unison, as observed in partial paralysis and in a state of fatigue.

The forms of interrupted respiration described above do not depend on the condition of the lungs or bronchi; they may be noted in given cases by direct auscultation, but frequently they can be recognized at a distance.

Clinically this form of respiration is limited (after excluding the causes mentioned above) to the interruptions of the respiratory sound heard by direct auscultation. The break in rhythm may be caused by temporarily stopping or by diminution or increase of the respiratory sounds (Gerhardt). If the interruptions occur in the neighborhood of the heart and synchronously with its systole, the phenomenon is called systolic vesicular respiration (Wintrich).

Whereas opinions differ as to the importance of interrupted respiration when occurring in the inferior portions of the lung, its presence in the upper parts is recognized as a sign, and most often as an early one, of pulmonary tuberculosis in which disease it is actually of frequent occurrence. The following facts have been obtained from the examination of a large clinical material which has been studied to elucidate the cause of this form of respiration.

Of 268 patients treated during one year at the Sonnenberg Sanatorium

*Translated for the *Journal of Tuberculosis* from the *Deutsches Archiv. f. klin. Med.* 1, XXIV, 1-2.

for tuberculosis 39 or 14.5 per cent. presented the symptom of interrupted respiration. In 19 this phenomenon was observed in various circumscribed, isolated portions of the lungs as follows:—

| | |
|---------------------------------------|---------------------------------------|
| Right upper lobe, anterior, 13 times. | Right upper lobe, posterior, 3 times. |
| Right lower lobe, " 5 " | Right lower lobe, " 4 " |
| Left upper lobe, " 14 " | Left upper lobe, " 2 " |
| Left lower lobe, " 8 " | Left lower lobe, " 16 " |

In seven of the eight which showed the phenomenon in the left lower lobe anteriorly it was perceptible over almost the entire anterior, left, thoracic wall. On the left side it was observed 40 times, on the right 25 times. In patients suffering from pulmonary disease Schultzen observed interrupted respiration in 16 cases, ten times on the left, six times on the right side, and four times bilaterally. Of the 39 patients observed by me, 26 were in advanced stages corresponding at least to the second stage of Turbau. Tubercle bacilli were found in the sputum in 29, i. e. in 69 per cent.

Of 88 young men, recently discharged from military service, who were examined as to the presence of interrupted respiration in healthy individuals, the phenomenon was only observed in four cases. In two of these who presented the symptom in the upper lobes a careful examination justified the suspicion that tuberculosis was the cause. Two very robust men, with otherwise normal lungs, showed interrupted respiration on the left side below the angle of the scapula; both stated that they had suffered from pneumonia on left side some years ago.

Excluding the tuberculous suspects, interrupted respiration was observed in 86 healthy individuals only twice, i. e. in 23. per cent. as compared with 14.5 per cent. in tuberculous patients. The interrupted breathing was principally audible during inspiration; at times it was present only during expiration, the intensity of which was then always increased. In some cases it was noticeable at the height of inspiration for a moment only and then it was but barely audible. The inspiration was either vesicular, or, as was the rule in the upper lobes, anteriorly, it was harsh; a few times it was bronchial; occasionally it was diminished. The various interruptions could best be differentiated at the commencement of inspiration and they decreased in distinctness toward its end. Generally two to four or more interruptions could be distinguished. The intermittent character appeared mostly as an augmentation of the respiratory murmur; less frequently the latter was interrupted in the sense that it stopped completely and was thereafter renewed; a weakened character was also rare.

Points of predilection for interrupted breathing were the first and second intercostal spaces on either side and the left subscapular region. The extent of the area was sometimes limited to very small portions of the lungs, a part of an intercostal space for instance. Occasionally it embraced the entire lobe. On the left side interruption was usually audible over a larger area than on the right. In the left as well as the right lower lobe posteriorly it extended over large areas. Here the interrupted respiration, in contrast with that in the upper lobes, was mostly vesicular in character and occurred at times when but a slight circumscribed affection existed in one apex. In the posterior and inferior areas where interrupted respiration was observed, evidence of previous pleural inflammation could, as a rule, be demonstrated by a shortened percussion note, diminished fremitus and weak inspiration, and in these particular instances by the addition of an interrupted character of the latter. Among the cases studied, there were, however, a few which, although showing evidence of an old pleurisy over the region of one lower lobe, manifested interrupted respiration on the opposite side, where not a trace of antecedent pleurisy could be detected.

The interrupted breathing was often noticeable for a long period at one and the same spot; in some cases it disappeared without leaving any trace, or alternated with other signs.

Jacob E., 30 years old, workman in glass factory, complained of stitch like pains in the right side at border of lung. Only interrupted breathing without evidence of pleurisy was found at the seat of pain. The latter disappeared rapidly and with it also the interrupted respiration.

Peter B., 43 years old, locksmith. Infiltration and catarrh of right upper lobe and of left apex. Over left lower lobe, posteriorly, there was interrupted breathing which after three weeks was replaced by râles.

The association of râles with the interrupted breathing was but rarely noted. Turban observed interrupted respiration most frequently "from the margin of the diseased lung portion downward, for instance in front in the first and second intercostal spaces," and supposed its point of origin to be in functioning lung-tissue in the neighborhood of infiltrations.

In the cases which I have studied, besides the alterations in rhythm, signs of thickening, softening and catarrh were almost always noticeable above the area where the interrupted breathing was observed.

Not considering the extrinsic causes for the production of interrupted breathing, the almost exclusive explanation given for its production is obstructions which oppose the air current. Sahli believes it to be due to a valve-like obstruction of bronchi by mucus and pronounces it related to rough respiration, an opinion also held by Turban. That accumula-

tion of mucus is the cause of this particular phenomenon is not probable, because one can hardly conceive that accumulated mucus should produce such an alteration over an entire lobe of a lung in the absence of any other catarrhal signs, whereas this sign is but rarely observed in areas in which we find most frequently signs of accumulated mucus, as in the apices above the clavicle and the spine of the scapula. Rather would valve-like swelling of the mucons membrane account for the phenomenon, but we have no anatomico-pathologic basis for the involvement of an entire lobe by such a condition.

A special form of interrupted inspiration has been called "systolic vesicular respiration," because the interruptions occur synchronously with the systole of the heart. Wintrich was the first to mention it, but he observed it in the neighborhood of the heart only. He explains it as an aspiration of air, caused by the systolic contraction of the heart.

Gerhardt attributes to this phenomenon a diagnostic importance as indicating adhesions of the lung-margin in the region of the heart. Sahli denies that it has any pathologic importance and agrees with Wintrich, that it depends on the negative pressure in the interior of the thorax associated with "the systolic decrease in volume of the heart." According to Sahli it is noticeable at times on cessation of breathing.

It is certainly possible of physical explanation that in consequence of a systolic aspiration of air, the respiratory murmur in the vicinity of the heart should become interrupted during the systole.

Volland has made the observation that in phthysical patients the interrupted character of the respiration is synchronous with the contraction of the heart. Curiously enough he found the phenomenon only on the left side. Brecke confirmed Volland in so far that he found interrupted respiration synchronous with the heart's action, not only in the cardiac region but also in other portions of the lungs, most frequently in the lower and only rarely in the upper lobes.

I have also gained the impression that as a rule interrupted breathing corresponding to the rhythm of the pulse, occurs in tuberculous patients. Seeing in this relation at the same time an etiological explanation of this important symptom, I shall briefly describe the method of examination which I followed for its elucidation.

In examining this relation by observing the apex-beat or the radial pulse at the same time as we auscultate the area where the interrupted respiration occurs, there is a great liability to error unless the observer has a well trained ear. This is more particularly the case when the heart's action is weak or when the interruptions are not well marked.

Apart from this it is often quite difficult to appreciate the simultaneousness of what we hear and feel. In almost all cases in which pulsation and interruption were sufficiently distinct, the coincidence appeared to me beyond doubt.

The dependence of the interruptions on the frequency of the pulse can be recognized more easily if through active bodily movements, as for instance running, an acceleration of the heart's action is produced.

As mentioned above, we can easily distinguish two, three or four interruptions, principally during inspiration. By counting the interruptions before and after the acceleration of the pulse caused by running I found *ceteris paribus* the number of interruptions correspondingly increased before every inspiration.

Still more distinct becomes the increase in interruptions under inhalation of amyl nitrite. Especially with the commencement of the action of the latter and when with the acceleration of the pulse an elevation of the blood pressure occurs, the increase in the interruptions appears with great distinctness and they are then much more accentuated.

A few examples may serve for illustration:

Paul D., 22 years. Factory hand. Over right upper lobe to second rib and to the spine of scapula moderate dullness, sharp interrupted respiration without other adventitious sounds. On left side was found moderate dullness to the second rib and almost to the middle of scapula with sharpened inspiration and few râles. On left side posteriorly, from angle of scapula downward there was interrupted, vesicular respiration. Before the inhalation of amyl nitrite three to four interruptions, growing less distinct toward the end of the inspiration could be noted; soon after the action of amyl nitrite took effect (which also showed itself externally by hyperaemia of the skin) five to six interruptions were counted.

Jacob E., 33 years, glass blower. Infiltration and slight catarrh of both upper lobes, laryngeal tuberculosis. Heart normal position, heart murmur audible below left scapula. Over right upper lobe, anterior, and lower lobe, posterior, interrupted breathing. Number of interruptions three to four, which changed to six to seven after administration of amyl nitrite.

The cases mentioned above, the number of which could be easily increased, do not permit any other interpretation than that the interrupted breathing is dependent on the heart's action.

The systolic aspiration of air which offers a sufficient explanation for the production of the so-called systolic vesicular breathing when noticed in the neighborhood of the heart, cannot be accepted as a uniform cause of interrupted breathing corresponding to the pulse in rhythm, because it also occurs at locations, as for instance the right apex, which are too distant to admit of such explanation.

I believe, however, that in the assumption of a hyperaemia of the

lung-tissue, as the cause of interrupted breathing corresponding to the pulse rhythm, a satisfactory explanation has been given for the presence of this phenomenon at portions of the lung distant from the heart.

By the systolic capillary dilatation in the midst of hyperaemic, inflamed lung-areas, a local impediment is given to air entering the finest ramifications of bronchi, which causes the interruptions of the respiratory murmur to be heard.

This hypothesis would support Turban's observation that interrupted breathing occurs in the upper portions of the lung, principally at the margins of infiltrations, because here rightly a local hyperaemia may be assumed.

The presence of isolated, interrupted breathing, corresponding to the pulse rhythm in the posterior, inferior portions of the lung after pleurisy or pneumonia could also be explained by the assumption of a hyperaemia. If one considers that pleurisy and pneumonia frequently occur in the same individual at the same locality and often leave behind permanent interrupted breathing corresponding to the pulse-rhythm, the idea of a *locus minoris resistentiae* would receive support in the assumption of a persistent hyperaemia following such inflammatory processes. The fact that râles (see above) may succeed the interrupted breathing corresponding to pulse-rhythm would speak for a hyperaemia preceding a secreting catarrh. In the same way the interrupted systolic breathing at the beginning of a pleurisy or as an accompanying symptom of pleurodynia could be sufficiently accounted for by congested conditions of adjacent lung-tissue. The hypothesis that hyperaemia of lung-tissue causes interrupted breathing corresponding to the pulse-rhythm, is supported by the following observations.

Johann Th., 30 years, assistant surveyor. Slight diminution in percussion note of right upper lobe, diminished respiration with prolonged expiration. After several injections of tuberculin, which did not cause any reaction, a dose of 0.01 g. was followed by interrupted breathing corresponding to the pulse-rhythm as the only symptom of local reaction.

George W., 22 years, mason; very powerfully built man. Slight diminution in percussion note of right apex, rough respiration, no râles. No cough and no sputum. Following a trial injection of tuberculin of 0.6 mg. his temperature rose to 38.3° C. On right side supraclavicularly, interrupted respiration corresponding to the pulse-rhythm and a few râles were present.

Mathias P., age 19, locksmith. Left upper lobe, percussion note short, weak inspiration, a few dry râles. After repeated tuberculin injections, temperature rose to 39° C. In left apex sharp, interrupted respiration synchronous with heart's action and râles increased in number.

According to the views of most experts on tuberculin, the latter pro-

duces an increased hyperaemia in the diseased portions. Supposing that the action of tuberculin created a hyperaemia in the portions of the lung suspected of tuberculosis, the causation of the interrupted breathing corresponding to the pulse-rhythm may be explained in the cases described by the above mentioned hypothesis.

Of the foregoing statements the following are to be repeated:

1. Interrupted breathing is chiefly noticeable in jerks, corresponding to the pulse-rhythm.
2. Interrupted breathing corresponding to the pulse-rhythm is frequently a sign of hyperaemia of that portion of the lung in which it is observed.
3. Interrupted breathing corresponding to the pulse-rhythm often indicates remains of former inflammatory processes of the lung or pleura, or permits the assumption of still existing inflammatory conditions of adjoining lung-tissues.

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REVIEW OF CURRENT LITERATURE.

THE INTERCOMMUNICABILITY OF HUMAN AND BOVINE TUBERCULOSIS.

At the annual conversational meeting of the Pathological Society of Philadelphia, April, 24, 1902, Dr. Mazyck P. Ravenel delivered an address on this subject which was subsequently published in the *University of Penn., Med. Bulletin*, May, 1902.

"The relation", says Ravenel, "that exists between human and bovine tuberculosis, and the part played by cattle in spreading the disease among mankind, is now the great question to which attention has been drawn with renewed activity by the attitude of Prof. Koch, announced in his paper before the British Congress on Tuberculosis in July, 1901." Passing over minor differences of opinion, the author at once enters into the consideration of the two main propositions which were formulated by Koch, and which include all points of controversy in the discussion of the relation between human and bovine tuberculosis.

I. The first of these propositions, in contradiction to the former teaching of Koch, denies the identity of human and bovine tuberculosis, and rejects the possibility of transmitting human tuberculosis to cattle. According to Ravenel, Koch based this statement on the result of an insufficient number of experiments made by Prof. Schütz and himself. A number of young cattle, proved to be free from tuberculosis by the tuberculin test, were infected in various ways with bacilli of human origin or with tuberculous sputum. "None of these cattle (there were nineteen of them) showed any symptoms of disease, and they gained considerably in weight". After six to eight months they were killed, and no trace of disease was found in the internal organs. At the points where injections were made small foci of suppuration had formed in which a few bacilli were found.

On the other hand, inoculations of a similar nature with bacilli from the lungs of an animal with bovine tuberculosis resulted always in rapid illness which often caused death, while some of the animals were killed, after three months, in a miserably sick condition. In all these cases extensive tuberculosis was found, involving the internal organs, especially the lungs and spleen.

A similar difference in pathogenicity was demonstrated in feeding experiments with pigs of which one lot of six received human tuberculous sputum, while a second lot of six were given pure cultures of the

bovine tubercle bacillus; and also in experiments on asses, sheep and goats in which the inoculations were made with pure cultures of human and bovine bacilli into the circulation.

It cannot be denied that these, as well as similar results obtained by others, show that cattle, as a rule, possess a high degree of resistance to the human tubercle bacillus, but they do not prove that man is insusceptible to the bovine germ.

Villemin held human and bovine tuberculosis to be identical, because small animals like rabbits became tuberculous following the injection of material from man as well as from cattle. Chauveau, however, first attempted to infect cattle with human tuberculous material. He made three series of infections, infection by the digestive tract, infection by intravenous injection, and infection by subcutaneous inoculation. As controls in the first series other similar animals were infected with bovine material and others again were not infected at all. While these last remained free from tuberculosis, those to which bovine material had been fed as well as those which received human material, became tuberculous. At autopsy it was impossible to distinguish one group from the other and in all of them the lesions provoked showed the same character.

In the second series, a calf, injected into the jugular vein with 2 c. c. of an emulsion made from the lung of a child with acute miliary tuberculosis, was killed on the twenty-ninth day. The lesions were confined to the chest, the bronchial and mediastinal ganglia showing the most marked changes, while in the lung, on section, there were found well-marked gray granulations, accumulated in the interior of or around the small bronchi which they sometimes occluded entirely.

In the third series seven animals were inoculated subcutaneously; for three of these the material used was obtained from fungous masses from the joints in cases of white swelling; from three others from acute miliary tuberculosis, and from the remaining animal, from the lung of a horse which had developed a marked pulmonary tuberculosis due to the intravenous injection of material from the lung of a man.

In each case a tumor developed at the point of inoculation which Chauveau describes as being a tuberculous tumor altogether typical. The neighboring glands showed always more or less involvement, but in no case was there any general infection.

Bollinger in 1879 inoculated a young calf in the peritoneal cavity with material from a human lung. When killed, after seven months, the mesentery and peritoneal covering of the spleen presented a number of tumors which microscopically were identical with those found in pearl

disease under natural conditions; the retro-peritoneal and mesenteric glands were tuberculous also. Klebs, Kitt and Crookshank have made like experiments with similar results, while the calf infected by the latter, died on the forty-second day and on autopsy was found extensively diseased, the mesentery, under surface of the liver, the spleen, gastro-splenic omentum, peritoneal surface of diaphragm, and the lungs being involved. Tubercle bacilli was found in these organs and in the peritoneal deposit.

Sidney Martin fed human tuberculous sputum to six calves, four of which received 70 c. c. mixed with their food at one meal. Three of these which were killed after thirty-three, sixty-three and eighty-five days respectively showed tuberculous nodules in the intestine; the fourth remained free from disease. The two other calves were given 440 c. c. of sputum at one feeding. One was killed after fifty-six days and showed tuberculosis of the intestine and mesenteric glands. The other was allowed to live one hundred and thirty-eight days and was free from disease when killed.

Recently Prof. Thomassen of Utrecht inoculated a four weeks' old calf in the anterior chamber of the eye with a pure culture of the tubercle bacillus isolated from a case of tuberculous arthritis in man. An intense keratitis was set up and the animal, when killed after six weeks, was found to have a pretty well generalized tuberculosis. Both lungs contained numerous miliary tubercles and some gray, fibrous tubercles of larger size, and the path of infection from the eye to the lung was mapped out by the condition of the subparotideal, cervical, mediastinal and bronchial lymph glands of the same side.

Nocard states that by inoculation into the arachnoid cavity of a small amount of human tubercle bacilli a rapidly fatal tuberculous meningitis is set up, identical with that seen in children. A calf, five months old, was thus inoculated by him on August, 2, 1901, and died on the 28th of the same month, the pia mater being infiltrated with tubercles which proved virulent for guinea pigs. Other experiments are reported by Arloing and de Jong.

The objection may be made to many of these experiments that the tuberculosis resulting from the inoculation did not cause death nor even serious illness, and some of the animals would probably have recovered entirely had they not been killed. It may, however, be pointed out that many cattle which have become infected under natural conditions remain for years apparently in perfect health, so much so that the detection of the disease is possible only by means of tuberculin. So also in man many cases of tuberculosis run a benign course, or remain stationary for years,

while not a few end in recovery. Yet in man and in animals, these benign cases, may take on an acute, rapidly progressive form.

No one would hold that because of the benign course of the disease in the first instance, true tuberculosis did not exist.

In several of the instances recorded of cattle having become infected through the sputum of phthisical attendants the evidence is so clear as to leave no doubt that cattle are at times infected in this manner. Such instances have been reported by Cozette, Cliquet, Huon, and Bang.

Ravenel proceeds now to speak of the work done at the laboratory of the State Live Stock Sanitary Board of Pennsylvania of which he is the bacteriologist. The first successful attempt, in this laboratory, to infect cattle with human tuberculosis was made in 1898, when four calves, four to five weeks old, received intraperitoneally 10 c. c. of human tuberculous sputum, from different sources, but in all instances containing a large number of bacilli. In one the autopsy was entirely negative. Of the other three, two had persistent high temperature following the injection, and only one showed marked illness otherwise. Of this last the author says that the lesions were so extensive and typical that even the most skeptical must admit the success of the experiment. This calf, aged four weeks, was inoculated, May 16, 1898, with sputum containing a large number of tubercle bacilli, from an early case of pulmonary tuberculosis. Soon thereafter the temperature rose and continued high with some remissions, until it was killed. Its appearance was bad, coat dry and rough, respiration rapid. It was tested with tuberculin, but the temperature was too high for results. When killed, August 1, the mediastinal and bronchial glands were enlarged and congested, and of the former some were caseous. The peritoneum, spleen, whole omentum, abdominal surface of the diaphragm and the mesentery all presented nodules, from 2 mm. to 12 mm. in diameter. In the omentum were also three large masses, dense and fibrous in character, two of which were 15 cm. long by 7 cm. wide and 12 mm. thick. The mesenteric glands were enlarged and somewhat caseous.

For several years past Ravenel has endeavored to obtain material from cases of tuberculosis in children in which there was evidence of infection through the alimentary tract, reasoning that if children contracted tuberculosis by the ingestion of milk from diseased cattle, bacilli of the bovine type would most likely be found in these intestinal or mesenteric lesions. In one such case in which the evidence of primary intestinal infection was clear and in which the immediate cause of death of the child was tuberculous meningitis, from a mesenteric gland a cul-

ture was isolated which has for cattle the most intense pathogenic power. Two calves and a grown cow, inoculated into the jugular vein and peritoneal cavity, died in nineteen, twenty-seven and eighteen days respectively, all of the animals having exhibited marked symptoms from the day of inoculation. Examination of the lesions, both macroscopical and microscopical, left no doubt that the animals succumbed to a pure tuberculosis. The calves had been tested with tuberculin previous to the inoculation, but gave no reaction. The author describes in detail the autopsy findings in the child from which the culture was obtained and also those of the respective animals, and says that one of two propositions must be admitted as an interpretation of the results; either a human tubercle bacillus has been found which has a pathogenic power for cattle quite as great as any bovine germ, or else from the mesenteric gland of a child a bovine tubercle bacillus has been isolated. If the law of diagnosis laid down by Koch, namely the inoculation test, be accepted, then Ravenel is strongly of the opinion that the latter is the true explanation for the following reasons:—

1. The history of the case as primary intestinal infection.

2. Morphologically and culturally the organism corresponds more nearly to the bovine type as first defined by Theobald Smith than to the human.

3. The great pathogenic power for cattle.

A second culture, obtained from the mesenteric glands of a child whose death was due to tuberculous meningitis, has shown a virulence far in excess of that usually found in human cultures. It was isolated in 1900 and tested for guinea-pigs and rabbits with results which, together with its manner of growing and microscopical appearance, led to its being considered as a typical human culture. In 1901 it showed an unexpected degree of virulence for puppies and later, when it was employed to produce a slow tuberculosis in a dog, the dog rapidly grew ill and died thirty-six days after the inoculation. Post-mortem examination revealed a typical and extensive tuberculosis and it was decided to inoculate a calf in order to test its virulence for the bovine species. A calf was accordingly inoculated in the jugular vein with 6 c. c. of a suspension of this culture, of the twelfth generation, from glycerin agar. The result was a well marked tuberculosis proving that the culture with which the animal was inoculated, possessed a degree of virulence above that usually found in cultures of human origin. The author states that the experience with this culture leads him to believe that the usual method of employ-

ing only guinea pigs and rabbits in testing the virulence of the tubercle bacillus, does not always give entirely conclusive results.

In another experiment it has been proven that a typical tuberculosis can be produced in young cattle by large and repeated doses of a human culture of moderate virulence; and even more interesting and important is the fact that by successive passages through calves success has been attained in bringing about a marked increase in the virulence of this culture. The culture employed was isolated from human sputum in September, 1899. The animals were inoculated at intervals of a week, the amount of culture being divided into four equal portions which were injected into the jugular vein, the lung, the peritoneal cavity, and under the skin. Each week the dose was increased by 10 c. c. Two calves were infected in this manner. With the tissues of one of these the serial inoculations were begun, a second calf being inoculated therewith; a third calf was inoculated with tissue from the second, a fourth with tissue from the third and a fifth with tissue from the fourth. The first calf of this series died after 106 days, the second, third, fourth and fifth succumbed after 48, 23, 24 and 24 days respectively. The author describes in detail the clinical observations and the post-mortem findings in these animals and he feels that he has demonstrated a great increase in virulence in this culture obtained from sputum by the several passages through calves, and he asserts that by his own experiments, as well as by those of others, it is demonstrated that Koch's statement that human tuberculosis cannot be transmitted to cattle is erroneous and untenable.

In the second proposition Prof. Koch questions the possibility of the transmission of tuberculosis from cattle to man, and holds that if such transmission ever does take place, it is a very rare occurrence, so rare indeed, as to render superfluous any measure of precaution against it.

In the solution of these problems direct experimental data are unavailable, so we must gather evidence from every possible source and weigh it carefully. First, is tuberculosis in cattle marked by any specific features which differentiate it from tuberculosis in man, and which would make it improbable that the two were intercommunicable. The chief characteristics of bovine tuberculosis are the marked tendency to calcification rather than to the caseation seen in man, and the formation in the serous membranes such as the pleura and peritoneum, of extensive new growths of wart-like, cauliflower or grape-like shapes from which the names "pearly disease", "perlsucht", "grape disease", etc., as applied to bovine tuberculosis, are derived.

Virchow, who since 1863 has insisted that the two tuberculosis are

distinct, did not accept Koch's conclusions, and said that in the autopsies at the Charitè, several cases were found presenting an unusual peritoneal tuberculosis with enormous growths, such as are seldom seen in man. These cases he regarded as being possibly of bovine origin through food.

Schüppel first demonstrated the histological identity of human and bovine tuberculosis and his work has been supplemented by Baumgarten. Troja and also Theobold Smith has shown that pearl disease may be produced in rabbits by the human tubercle bacillus.

The differences between tuberculosis of man and that of cattle are scarcely greater than those noted between the latter and tuberculosis of swine, yet nothing is easier than to infect swine with milk or other products of tuberculous cattle. The infection here is by natural methods and the origin of the infection is unquestionably bovine, yet the disease produced differs markedly, but not essentially, from that seen in cattle. By the evidence then, we are led to conclude that such differences as are commonly seen between human and bovine tuberculosis are in no sense essential.

That morphologically and culturally certain differences exist between cultures of the tubercle bacillus from man and from cattle was shown by Theobold Smith and has been confirmed by a similar study at the laboratory of the State Live Stock Sanitary Board of Pennsylvania. The results of Ravenel's observations which have agreed closely with those of Dr. Smith, are as follows: The morphology of the bacilli in cultures of bovine origin is more uniform and constant than in cultures from man. The characteristic differences between human and bovine bacilli are most marked and most persistent in cultures grown on blood serum. The morphological distinctions tend to disappear by continued cultivation on glycerin agar, glycerin bouillon and glycerin potato, and also in the tissues of susceptible animals. The optimum temperature as well as the thermal death-point are practically the same. The most striking dissimilarity is, however, seen in the action of the bacilli from the two sources on animals. By whatever method of inoculation, the bovine bacillus, as a rule, possesses a very much greater pathogenic power than the human bacillus for all animals on which it has been tried, the only exceptions being possibly those animals, like guinea-pigs and swine, which are so extremely susceptible to both types that it is hard to draw any distinctions between them.

What has been said concerning the greater pathogenic power of the bovine germ has been proven beyond question to be the rule, but has the

bovine tubercle bacillus more pathogenic power also for man than the human bacillus?.

Until the contrary is proven or until good reason for believing the contrary is shown, the author feels that this must be the conclusion, for although virulence is a factor which is relative to the subject and exaltation of virulence for one species of animal does not necessarily prove an increased power for other species, the reverse, indeed, sometimes being true, it is nevertheless a firmly established rule in bacteriology that when the virulence of a pathogenic organism is increased for one animal it is increased for all that are naturally susceptible to it, as well as for those in which the disease is known only experimentally. That the tubercle bacillus by its residence in the tissues of cattle has not become an exception to this established rule, is proven by the cases of accidental inoculation of man with the bovine bacillus, as well as by the cases observed clinically in which tuberculosis has followed the consumption of tuberculous milk.

While we cannot determine the virulence of the bovine tubercle bacillus for man by direct inoculation, accidental inoculations have been observed from time to time. Four such cases have been reported to this society. Similar cases have been chronicled by Tscherning, Pfeiffer, Hartzell, Kurt Mueller, de Jong and others, in all of which the authors felt that they were able with reasonable certainty to exclude other sources of infection. Of thirty-four cases of verrucous tuberculosis of the skin observed by Lassar, four were in butchers, while on the contrary, among those affected with other forms of tuberculosis localized in the skin, none belonged to this calling. Liebreich said he had been able to assure himself that verrucous tuberculosis was much more common among those whose duties require handling tuberculous meats than among others.

It would seem that instances of infection through wounds are not as uncommon as has been supposed heretofore. Their value has been questioned on the ground that inoculations do not always correspond to natural infections. While such cases do not settle the whole question definitely, they nevertheless prove beyond doubt that there is no peculiar quality in the tissues of man which makes him an unfit soil for the bovine tubercle bacillus. We know from experimental as well as from clinical evidence, that the skin is the tissue most unfavorable to the growth of the tubercle bacillus. If, then, the bovine bacillus can successfully invade the skin and multiply there, with the production of characteristic changes, it seems we are fully justified in believing that organs and tis-

sues that are known to offer favorable soil to the human bacillus will also prove favorable to the bovine organism. On the other hand, Ravenel knows of no animal which is susceptible to the human bacillus yet immune to the bovine.

As concerns tuberculous infection through food, Koch says, "that a case of tuberculosis has been caused by aliments can be assumed with certainty only when the intestine suffers first—i. e., when a so-called primary tuberculosis of the intestine is found", and he cites post-mortem statistics which indicate that such cases are very rare. But the assumption that the proportion of tuberculosis caused by food is correctly revealed by the lesions of the intestine or mesenteric glands is certainly erroneous, and leaves out of consideration entirely at least one very important avenue of infection, viz., that through the tonsils.

The numerous observations made of late years leave no doubt that the tonsils sometimes act as the port of entry for the tubercle bacillus. Baup, Dieulafoy, Latham, Friedmann and others who have studied this question, give corroborative facts which are sufficient to show the fallacy of looking exclusively to the intestine for the proof of a food infection. When we remember the frequency with which children are fed, and the ease with which particles of food lodge on the tonsils, we cannot but think that Friedmann is reasonable in his conclusion that tuberculosis of the tonsils is quite common in children and that the infection takes place directly from food, and not through the lymph, blood, or by inhalation.

The number of cases in which infection can be traced to the consumption of tuberculous milk is not large, and almost all of them are open to some criticism from the fact that all other sources of infection cannot be positively excluded. However, evidence in some of the cases is so clear that Nocard has well said: "It has almost the value of an experiment", and it is quite sure that we would unquestioningly accept evidence of much less value if any other disease than tuberculosis were concerned. Besides the well-known cases reported by Stang, Demme, Gosse, Ollivier and Law, others are reported by Ebers, Bang, von Ruck, Klebs and Rievel, all of them giving very good reason to believe that milk was the agent of transmission for the tubercle bacillus.

The reports of pathologists based on autopsies prove conclusively that in a certain proportion of persons dying of tuberculosis, and especially in children, the infection takes place through the intestine. In general the determination of the primary lesion is based on the belief that the lymphatic glands in children give evidence of the duration and extent of tuberculous disease in the organs with which they are in rela-

tion. Consequently if the bronchial glands show more advanced caseation than the mesenteric, the infection is put down as having occurred through the respiratory tract. The fallacy of this has been demonstrated as regards infection through the tonsils, and that it is correct, even when the absorption takes place through the intestinal mucosa, is open to question. During intestinal digestion there is a constant current from the intestine to the mesenteric glands, and thence up the thoracic duct into the venous circulation. Any tubercle bacilli which may have gained entrance into this stream are carried almost immediately into the lung, and deposited there by election.

It has been shown by Dobroklonski that the tubercle bacillus can penetrate the wall of the intestine in the absence of any demonstrable lesion, that the tuberculous virus can easily pass through the epithelial lining of the intestine when it is entirely normal.

The observers at the laboratory of the Pennsylvania State Live-Stock Sanitary Board have often been struck by the extensive involvement of the lungs in animals infected by feeding, and the slight injury of the intestines. Indeed in some animals it has been impossible to detect any involvement of the intestine at all. With these facts in view it seems not impossible that an infection gaining entrance through the intestine may appear first in the lung, and thus be erroneously attributed to the respiratory tract. On one point all pathologists as well as clinicians seem to agree, that in children tuberculosis shows a marked tendency to become generalized, and this occurs with such rapidity that it is often impossible to decide where the infection gained entrance.

The tremendous mortality of children from tuberculosis has forced us to pay particular attention to the study of the factors at work in early life, and a number of interesting and valuable autopsy records have been published. From England we get the most positive evidence of infection through the intestine, and the most striking proofs of its frequency. English pathologists are practically unanimous in regarding the intestines as a frequent path of infection, the primary lesion being associated with this tract in about 25 per cent. of all cases. German statistics indicate that primary intestinal tuberculosis is not so common in that country as in England, which we would hardly expect considering the precautions prescribed in Germany and the lack of regulations in England.

There has been and is considerable discussion as to the stage of the disease at which a tuberculous cow becomes dangerous through the passage of tubercle bacilli into her milk. Investigations of this question by various experimenters have shown that, while tuberculosis of the udder is

the most dangerous condition, we cannot by any means regard the milk of cows, with general tuberculosis, although the udders are free from disease, as being safe for food.

A few years ago Möller announced the discovery of a bacillus having the morphology and staining reactions of the tubercle bacillus. The property of resisting decolorization by mineral acids was for a long time considered diagnostic of the tubercle bacillus. Petri, Rabinowitsch, Grassberger, Korn and others have demonstrated that acid proof bacilli have a wide distribution in nature, and since a comparatively large group of organisms have the same staining property as the tubercle bacillus from which they are indistinguishable under the microscope, and since these bacilli also produce nodules in animals, we cannot rely on the microscope alone, but must depend upon reinoculation, microscopical examination of tissues, and the isolation of cultures to clear up the diagnosis in doubtful cases.

The evidence at hand forces us to conclude that human and bovine tuberculosis are but slightly indifferent manifestations of one and the same disease, and that they are intercommunicable. Bovine tuberculosis is, therefore, a menace to human health.

We are not in a position at present to define positively the extent of this danger, but that it really exists cannot be denied. In the past there has probably been a tendency to exaggeration, but, however great this may have been it does not now justify any attempt at belittling the risk, and it is folly to blind ourselves to it.

The eradication of bovine tuberculosis is amply justifiable from a purely economical standpoint; viewed in its bearing on human health it becomes a public duty.

TRANSMISSION OF HUMAN TUBERCULOSIS TO CATTLE.

In No. 38 of the *Berliner klinische Wochenschrift*, 1902, Fibiger and Jensen of Copenhagen have reported a series of experiments undertaken with the view of determining if the bacilli from cases of tuberculosis with especial localization in the digestive organs, for example, from chronic, local intestinal tuberculosis, behave differently from tubercle bacilli of human origin in general, and if possibly through their greater virulence for cattle they might betray their bovine extraction.

In the first experiment a calf was inoculated, April 22, 1900, into the pleural cavity with a suspension of material from a crushed mesenteric gland in which tubercle bacilli had been demonstrated, the gland having

been taken from a case (in an adult) of supposed primary intestinal tuberculosis, in which the autopsy had shown the tuberculous affection to be confined almost entirely to the caecum, vermiform appendix and ascending colon. On October 15, 1902, when the calf was killed, it was well nourished and healthy. In the lungs directly underneath the pleura and corresponding to the point of inoculation, were two miliary nodules. On the corresponding part of the pleura pulm were found isolated connective tissue proliferations and a few pearly nodules of the size of a lentil. A single similar growth appeared on the corresponding portion of the costal pleura. The result of the experiment was negative in so far as the bacilli had shown very little virulence for the calf.

The investigations were for a time suspended until the interest stimulated at the London Congress in 1901 caused them to be taken up again. Based upon his own experiments and those of others (Frothingham, Th. Smith) which showed that transmission of tuberculosis from man to cattle was not successful, Koch's conclusions that human tuberculosis differs from bovine tuberculosis and that transmission of the disease from cattle to man occurs with difficulty or very seldom takes place, have been sharply criticized. It has been brought forward with great emphasis that a primary tuberculous infection proceeding from the alimentary canal in children is not a seldom, but, on the contrary, indeed a rather frequent occurrence. Since Koch's communication various observations have been reported which prove that cattle are not absolutely immune to human tubercle bacilli, but that often, after inoculation typical tuberculous processes arise, although these usually do not pursue an active or malignant course.

The actual proof of the error of Koch's view, viz., the demonstration of cases in which the tuberculous changes are localized in the alimentary canal, in which the source of infection may in all probability be traced to milk, and in which finally the bacilli possess the same degree of virulence as the bovine bacillus, is still lacking. The object of the author's experiments is to determine the virulence of tubercle bacilli for calves:—

1. Partly in those cases in which, according to the post mortem findings it was indicated that primary infection by way of the alimentary tract might have occurred, and in which such an occurrence was not contradicted by the clinical course.

2. Partly in cases of undoubtedly primary intestinal tuberculosis.

Case II which is to be classed in the first category is that of a young woman of good family history who up to the time of her death had been

under observation at intervals for about fourteen years. During this time she had on three occasions been in hospital, first when eleven years old for the extirpation of tuberculous cervical glands; again at the age of twenty-three on account of chronic peritonitis. On neither of these occasions could evidence of tuberculous involvement of the lungs be detected. When admitted to the hospital the third time at the age of twenty-four she was suffering again from chronic peritonitis from which she died thirteen months later. This time physical examination of the chest revealed pneumonic infiltration and cavity-formation in the right lung with pleurisy of the right side.

The autopsy showed caseous cervical glands, ulcerating miliary tubercles in trachea and large bronchi, bilateral serous pleural effusion, a cavity with caseous walls in upper lobe of right lung, with diffuse pneumonic infiltration and irregular caseous foci in middle and lower lobes. The left lung was oedematous and contained caseous peribronchial and small pneumonic foci and scattered miliary nodules. The peritoneal cavity contained 2000 g. of sero-purulent fluid and there was tuberculous involvement of almost all abdominal organs, and tissues. Among the most marked changes were the following: numerous miliary tubercles of the serosa of the small intestine, scattered ulcerations in the ileum, large confluent ulcers in ileo-caecal region, large ulcers in the vermiform appendix which was filled with purulent masses, ulceration and stricture of the ascending colon, numerous enlarged caseous and calcified glands in the meso-colon, caseation and calcification in the mesentery and hilum of the liver; in the liver, spleen and kidneys large miliary tubercles.

From the analysis of this case it appears by no means improbable that the primary infection took place through the digestive tract and that the lungs were secondarily involved.

A three months old calf which had not responded to tuberculin was intraperitoneally injected, on June 9, with a suspension of a crushed tuberculous spleen of a guinea pig which, on April 21, had been infected subcutaneously with a portion of a tuberculous mesenteric gland from the patient. The infection of the guinea pig was successful, the inguinal glands, spleen, liver and lungs having become involved in a tuberculous process. On November 2, the calf was killed and there were found numerous fine, red connective tissue formations and about twenty pearl nodules in the omentum. On the diaphragm were also new connective tissue growths and scattered nodules varying in size from miliary to that of a lentil. Fresh connective tissue in addition was present in the pleura. The result of the inoculation was therefore positive, typical

fresh tuberculous formations exactly like those of fresh pearl disease having been produced in the peritoneum, although the virulence of the bacilli was indeed slight.

Case III occurred in a six year old boy of good family history, but who in infancy had been artificially nourished. At the age of a year and a half he had whooping cough followed by pleurisy, and later measles, after which the cervical glands became swollen. Eighteen months subsequently the cervical glands became more and more swollen, and a tendency to diarrhoea appeared. When five and a half years old, the glands became still more swollen, the diarrhoea marked, and the child emaciated and grew weak. Of the further clinical course it is sufficient to state that some cough developed, that ronchi and râles were found in infrascapular region of both sides and that with a persistent diarrhoea the child gradually grew weaker and finally died of exhaustion.

The post-mortem findings included an apparently caseous focus in the left tonsil, tuberculous caseation of nearly all the cervical lymph glands, tuberculous ulcers of the upper portion of the ileum, one of which completely encircled the bowel, ulceration of the ileo-caecal valves, deep, confluent ulcers of the appendix vermiformis, fibrous strictures and ulceration of the colon, tuberculosis of the lymph glands of the mesentery, meso-colon, porta hepatis, etc., some fibrous and other caseous; miliary tubercles in left kidney and left adrenal, and in the spleen. There were acute tuberculous changes in the lungs, but no cavities and only a single caseous focus of the size of a pea. On microscopical examination of the tonsils, miliary tubercles and extensive hyaline fibroid changes were found.

In view of the chronic cicatricial lesions of the intestine and tonsil as compared with the acute changes in the lungs, the authors consider that in this case infection probably occurred primarily by the alimentary route.

A young red calf which had stood the tuberculin test was, on June 9, inoculated intraperitoneally from a tuberculous spleen of a guinea pig which had been infected from the case above described. The calf was killed September 2. The omentum was generally involved with extensive fresh tuberculous neoplasma, a few of which showed beginning caseation. Similar changes, although of much less extent were present in the peritoneal investment of the uterus and ligament uteri, in the rectum and mesentery. In a few places were small groups of pedunculated pearl nodules, some of which showed destructive changes interiorly. There were scattered pearl nodules of the splenic and hepatic surfaces and

involvement of the lymphatic glands of the liver, stomach and mesentery. Some fresh connective tissue growths were present in the pleura, but no tuberculosis in the lungs.

Case IV, that of a 19-months girl baby (twin) of good family history, which had been artificially nourished, was admitted to hospital because of ileus with stercoraceous vomiting which rendered laparotomy necessary. At the operation there were found many adhesions of portions of intestine to one another and to the abdominal wall, numerous tubercles of the serosa of the large bowel, and in the iliac fossa a walnut sized caseous mass adherent to the parietal peritoneum. The latter was carefully removed and also a long rope-like adhesion to the omentum, which had caused strangulation of the bowel at one point, was separated. Death followed the operation.

At the autopsy, in addition to the pathological alterations noted at the operation, there were found numerous caseous glands of the retro-caecal region. Douglas' pouch was entirely obliterated by almost inseparable adhesions, imbedded in which and very difficult of extrication, were the adnexa.

In many portions of the small intestine, in the mesentery and parietal peritoneum, in the pelvis and in the iliac fossae, miliary tubercles and tubercles of the size of a hemp seed were found. The follicles of the lower part of the jejunum, as also of the entire ileum, were swollen and in part caseous, while the Peyer's patches were also swollen, caseous and superficially ulcerated. About two metres above the ileo-coecal valve was a stricture consisting of fibrous, partially necrotic, tuberculous tissue. The glands of the mesentery were caseous and the uterine mucosa was ulcerated and studded with miliary tubercles, the uterine cavity filled with yellow pus. The left tube and left ovary formed a tumor of the size of a walnut, the outer part of the tube contained caseous pus and the tubal wall presented ulcerations. Scattered caseous foci existed in the right ovary, and the right tube was also involved. In the lungs and associated glands as well as in the cervical glands, no signs of tuberculosis, even on microscopical examination, were demonstrable.

As the preceding evidence indicates, the case was one of primary tuberculosis of the intestinal canal with secondary extension to the peritoneum, ovaries and tubes, and finally through the latter to the uterine mucosa.

On May 29th, a young calf in which the tuberculin test had proven negative (highest temperature 39° C.) received subcutaneously in the right side of the neck a thin suspension of a crushed mesenteric gland

from the case just detailed. The gland contained tubercle bacilli. The calf was killed September 1. At the point of inoculation immediately under the skin was a firm tumor of the size of a silver quarter dollar which was partially caseous and partially calcified. In the vicinity of this lesion were numerous small nodules. The nearest lymphatic gland was 9 cm. long, 6 cm. wide and $1\frac{1}{2}$ cm. thick and contained a completely caseated and calcified focus which measured 3 cm. in length by $1\frac{1}{2}$ cm. in breadth. Additionally the gland presented swollen, irregular calcium deposits along the margins. Individual small glands in the neighborhood were also caseous. The lungs were disseminated throughout with miliary tubercles and tubercles of the size of a hemp seed. On the surface of the right lung was a single small, pearly nodule, while the pleural investment of the left lung presented a large number of similar formations, and along the border small pendent pearl nodules which were all fresh and not caseated. The bronchial and posterior mediastinal glands were swollen and contained small deposits of lime and recent caseous processes. On the hepatic surface were about ten small, pearly nodules, and in the tissues of the liver, kidneys and spleen scattered miliary tubercles. Fine red diffuse connective tissue growths involved the omentum.

Case V occurred in a four months' old boy who after the age of five weeks was artificially fed. He had four to five ill smelling clumpy stools daily, had never coughed and had emaciated markedly. When admitted to hospital, because of atrophy, the child was hoarse and coughed. Auscultation indicated normal conditions in the lungs. The stools were slimy and yellow. Some days later stethoscopy elicited many crepitant râles, but there was no percussion dullness; respiration was accelerated and the cough persisted. The chest symptoms subsequently subsided, and only occasional râles and normal conditions could be detected. The symptoms on the part of the bowel increased, with almost constant fever, until death.

On autopsy about two meters above the ileo-caecal valve was found a typical ulcer which penetrated to the muscularis and which extended transversely nearly one-half the circumference of the ileum. One half meter high was a similar ulcer and 70 cm. from the pylorus were two more transverse ulcerations. The vermiform appendix was also ulcerated and the entire colon from the valve of Bauhin into the rectum presented numerous sharply circumscribed ulcers, which in most instances extended to the muscularis, the largest of them involving transversely one-third of the circumference of the bowel. The glands of the mesentery were caseous. Numerous miliary tubercles were present throughout both

lungs and there were recent miliary tubercles in the liver, spleen and kidneys. Tubercle bacilli were demonstrated in the lesions.

This was also a case of primary tuberculosis of the intestine with secondary miliary tuberculosis of various organs.

On May 4, a few c. c. of a turbid fluid containing comparatively few tubercle bacilli but other germs, prepared by rubbing up a caseous mesenteric gland in normal salt solution, were injected into the right side of the neck of two ten days old calves, respectively.

Calf 1 succumbed on the twenty-first of the same month to a putrid, embolic affection of the lungs. At the point of inoculation was a firm mass, 9 cm. long, 7 cm. wide and 2 cm. thick, which on section presented a dry caseous surface and contained a small cavity. A neighboring gland, $4\frac{1}{2}$ cm. long, contained punctate haemorrhages and disseminated small, caseous spots. In the pus from the cavity were multitudes of tubercle bacilli and other microorganisms.

Calf 2 died on the twenty-third of the same month, likewise of a septic pneumonia. A like lesion occupied the point of inoculation and a neighboring gland presented an identical condition as in calf 1. Pus from the abscess cavity teemed with tubercle bacilli.

Although the calves succumbed early to pleuro-pneumonia, nevertheless in both a considerable local tuberculosis developed which, in view of the abundance of tubercle bacilli, would probably have engendered a malignant course.

A third calf was, on May 27, injected into the right side of the neck with material from calf 2. A phlegmonous process developed at the point of inoculation. The calf died July 16, and the autopsy showed, at the point of inoculation, a large tumor which consisted of fibrous tissue and contained many caseous nodules, as well as a large excavation filled with necrotic, caseous and purulent disintegrated, foul-smelling tissue. The neighboring glands were enlarged and completely caseated, as were also the middle and deep cervical glands. The pleuro-costalis and diaphragmatica, and to a less degree the pleura pulmonalis and pericardium presented fine red connective tissue formations. The lungs contained innumerable small nodules in portions so dense as to cause complete consolidation of large areas. There were, further, caseous processes of the bronchial and mediastinal glands, isolated, caseous nodules in the myocardium and scattered tubercles in the liver, spleen and kidneys. In the intestinal mucosa were found very numerous, quite recent nodules and small superficial ulcers.

The mesenteric, retropharyngeal, lumbar, axillary and inguinal

glands and the omentum were also involved. From tubercle bacilli demonstrated in the glands pure cultures were obtained on agar.

The cow, (10 years old) received on the left side of the neck a subcutaneous injection of material from calf 1. A phlegmonous swelling appeared *in situ* which led to the formation of a large abscess in the pus of which tubercle bacilli were demonstrated. The animal was slaughtered on the third of September. At the point of inoculation was a fibrous mass containing caseous foci; a neighboring gland was enormously enlarged and showed a few large caseous and calcified areas. In the lungs were scattered miliary tubercles, a few small nodules and two nut-sized pneumonic foci. One of the mediastinal glands was also partially calcified and there was a small number of tubercles in the liver. It is to be added that the animals used in this experiment had stood the tuberculin test.

Inoculation of calves from three cases of tuberculosis in children have proved that the bacilli derived therefrom were, in some instances, virulent even in the highest degree for calves and, therefore, it is but a step to the opinion that the disease in children resulted from infection with bacilli which originated from cattle.

Considered collectively, the results of the inoculations from all five cases showed every possible degree of virulence for calves, from entirely non-virulent to most highly virulent.

Although from so few observations and experiments naturally a conclusion cannot be arrived at, and although the variation in results in the experiments may be attributed to difference in virulence of the bacilli and to greater or less susceptibility of individual calves, the question readily arises: Is it not possible that tubercle bacilli become gradually attenuated in their virulence for cattle by residence in the human organism?

Koch claimed that the subcutaneous inoculation of calves with material from tuberculous human beings could be employed as a means to determine whether a given infection was caused by tubercle bacilli from an human or from a bovine source. If Koch's statement is correct, then, indeed, the three cases which have been detailed above are to be looked upon as pearl disease and therein the assertion of the harmlessness of bovine tuberculosis for mankind has found its refutation.

SOME FACTS WHICH SHOW THAT THE TUBERCULOSIS BACILLUS OF HUMAN ORIGIN MAY CAUSE TUBERCULOSIS IN CATTLE, AND THAT THE MORPHOLOGY AND VIRULENCE OF THE TUBERCLE BACILLI FROM VARIOUS SOURCES ARE GREATLY INFLUENCED BY THEIR SURROUNDINGS.

In *American Medicine* for November 24, appears a contribution to this subject by de Schweinitz, Dorset and Schroeder which was read at the Tuberculosis Congress in Berlin, Oct. 22-26, 1902. It is well known that tubercle bacilli obtained from various animals are largely influenced in morphologic appearances, depending upon the animal in which they happen to develop, and more especially upon the nature of the media and length of time of development upon artificial media. De Schweinitz inoculated a number of flasks of ordinary glycerinized beef-broth with tubercle bacilli derived respectively from the bird, the horse, the cow, the dog, the pig, carp and three varieties, differing in virulence, of the germ of human origin. These cultures were divided into three lots, one set allowed to grow for three weeks, another for about six, and another for about three months.

Preparations of the different germs made from each flask after these varying lengths of time showed that there was uniformly change in the morphology of the different germs, those that had been grown for the longest time differing very materially in appearance from those that had been grown for the shortest time. Also the most virulent germs showed less change in morphologic appearance than those which were less virulent, but even in these a change in the size of the germ that had grown upon the artificial media for the longest time was apparent.

The chemical composition of these same germs, as studied by de Schweinitz and Dorset, pointed to a closer resemblance between the bacilli of bovine origin and the virulent bacilli of human origin than that which exists between virulent bacilli of human origin and attenuated bacilli of human origin. Tuberculin prepared from a bovine culture produced the same characteristic reaction in man and cattle as the tuberculin obtained from a human culture, and also *vice versa*.

De Schweinitz has in his laboratory a culture of the human tuberculosis germ which is exceedingly virulent for small animals, and another which, originally very virulent for small animals, through long years of careful cultivation has become very attenuated.

De Schweinitz has already shown that an apparently positive immunity to tuberculosis in guinea pigs could be established by inoculating

them with this attenuated germ. The animals were tested by subsequently exposing them to a virulent germ.

To test the virulence for man of the bovine tubercle bacillus, which is uniformly so virulent for all varieties of animals upon which it has been tried, de Schweinitz and Schroeder inoculated subcutaneously baboons and the rhesus, as the nearest relatives of man, with bovine and human bacilli, using 1 c. c. to 5 c. c. of the liquid culture of the germs. Both the baboons and the rhesus succumbed to these inoculations, the autopsies showing very generalized tuberculosis, the lesions produced by the bovine bacilli being more marked, especially in the lungs, than those produced by the human germs. Next, heifers which had been previously tested with tuberculin and found free from tuberculosis, were subcutaneously inoculated by de Schweinitz and Schroeder with tuberculous material taken from the monkey that was dead from human tuberculosis. All other animals used in the authors' experiments had also been tested with tuberculin and found free from tuberculosis, so that there is no possibility of infection having come from any other source than the direct inoculation of the germ. After eight months these cattle were killed. The animal injected with tissue from the monkey that died of human tuberculosis showed no lesions except a small pocket filled with pus at the point of inoculation. The animal inoculated with the tissue of the monkey dead from inoculation with the bovine culture showed also a small pocket at the point at which the injection had been made, a slight abscess in the glands of the shoulder on the same side as the point of inoculation, and necrotic foci in the mediastinal glands. No other evidence of tuberculosis was present.

Another animal inoculated on Nov. 2, 1901, with 10 c. c. of the same virulent bovine culture (Bovine III, of Dr. Theobald Smith) as had been used for inoculating the monkey above referred to, was killed Oct. 2, 1902. At the seat of inoculation was a large indurated patch in which were imbedded numerous small abscesses containing a soft cheesy material; the superficial and deep shoulder-glands on the side of the injection, and the mediastinal glands were enlarged and sprinkled with caseous foci. No other lesions were found and the animal appeared in excellent condition.

These experiments show that the bovine bacillus may require a long time to produce evidence of tuberculosis in cattle, and they also suggest that the passage of the bovine bacillus through the monkey has apparently decreased its virulence.

Three cultures of tubercle bacilli isolated from cases of generalized

tuberculosis in children and grown upon an egg medium suggested by Dr. Dorset, have caused the death from generalized tuberculosis of calves of about four months of age; the calves having received a single intravenous injection of 5 c. c. of the respective cultures.

In another instance a positive result has been obtained in cattle by subcutaneous injections of material from generalized tuberculosis in a child.

The authors further state that they have at least three different cultures of human origin which they feel warranted in believing will produce disease in calves upon subcutaneous inoculation. The details of all this work will be published later as a *bulletin*.

From the facts established de Schweinitz concluded:

"The morphologic appearance of the tubercle bacilli derived from various animals is influenced greatly by the artificial media upon which the germs are allowed to grow and the length of time that the germs have grown upon such media. The virulence of tubercle bacilli derived from various sources is influenced by their growth upon artificial media, as well as by their passage through different animals. Bacilli can be and have been isolated from children affected with generalized tuberculosis, which have been, upon subcutaneous inoculation, as and more virulent for calves than the bovine bacilli used. Bacilli isolated from tuberculous children, which are very virulent for calves upon intravenous inoculation, appear also to be virulent upon subcutaneous inoculation. Several or even one positive case of the transmission of tuberculosis to calves by subcutaneous inoculation where the material has been obtained from a tuberculous human subject, prove positively the possibility of infecting cattle by the germ obtained from man. There is a difference in the virulence of germs isolated from different human subjects, and also a difference in the virulence of the germs secured from the various organs."

EXPERIMENTAL INGESTION TUBERCULOSIS IN COWS AND CALVES.

In the *Muenchener med. Wochenschrift*, No. 39, 1902, Prof. Max Schottelius makes a preliminary report of a series of experiments carried out in the Hygienic Institute of the University of Freiburg.

Two healthy calves and a cow, from May 25, to Aug. 29, 1902, received each in its food tuberculous human sputum, on twenty-four occasions, 50 g. being added each time. One calf and one cow were employed as controls, and these were found in a perfectly normal condition at

autopsy. On the other hand all three of the animals which were infected were found tuberculous. The post-mortem examination of the cow showed tuberculous enteritis, marked tumefaction of the mesenteric glands, tuberculous caseation and calcification of the mediastinal and bronchial glands, a caseous tuberculous pneumonia and isolated miliary tubercles of the pleura. Both calves presented much swollen tuberculous, caseous and calcareous submaxillary glands and a few tuberculous mesenteric glands.

In all three animals all the lymph glands of the body, including the lymph glands of muscles, were much swollen, partially mottled red, and sprinkled with pale foci of the appearance of necrotic areas. In all three animals tubercle bacilli were demonstrated in the affected parts.

The author considers his experiments particularly noteworthy, because artificial conditions were avoided and the animals were subjected only to natural conditions such as might obtain from the association with a tuberculous care taker. Furthermore he believes that the positive results of his experiments argue for the identity of human and bovine tubercle bacilli.

THE DEVELOPMENT AND COMBATting OF BOVINE TUBERCULOSIS WITH REMARKS ON SIMILARITY AND DIFFERENCE OF TUBERCLE BACILLI OF DIFFERENT ORIGIN.

Professor von Behring (*Berliner Thierärztlichen Wochenschrift*, 1902, No. 47.) in an address delivered Nov. 2, 1902, at the general meeting of the Society of Veterinarians of Kurhessen related his investigations in regard to the combatting of tuberculosis of cattle, and discussed the points of resemblance and of variance of tubercle bacilli of different origin.

After mentioning the remarkable behavior of Koch's bacilli toward basic aniline dyes and the peculiar property which they possess of resisting the influence of acids upon their stains, the author speaks of certain other things which have these characteristics (the spores of many micro-organisms, encysted coccidia, etc.), but which are readily distinguished by their form and size. It may not be such an easy matter, however, to distinguish the bacillus of Koch from certain other bacilli in the stained preparation, for example from the leprosy bacillus, the smegma bacillus; the bacillus of avian tuberculosis, the modified tubercle bacillus of Arloing, and from similar bacilli which are found in butter, upon grass, in the bodies of cold blooded animals, especially fish.

While all these bacilli are "acid proof" and all resemble the bacillus of Koch in form and size, they differ greatly in their cultural properties upon artificial media and in the animal experiment. It would be an error to group all these under the same name merely because of their resemblance in the stained preparation, but if we find that the conditions of the artificial culture soil and also the microscopic appearances differ materially, or again if we find that under equal conditions bacteria from different sources resemble one another microscopically and culturally, but nevertheless vary greatly in pathogenic power, are we right in concluding that we are dealing with different kinds?

As evidence of the incorrectness of such conclusions von Behring cites the anthrax bacillus which, at will, may be deprived of its property of producing spores, may be compelled to grow upon the surface of a bouillon culture, and may be so attenuated that it can never again cause anthrax, and would, therefore, have no claim to the designation of anthrax bacillus, but still phylogenetically it remains the same and this is the most important criterion for identity in kind.

Changes of such a nature as we are able to produce designedly in anthrax bacilli occur in other instances without our intervention. Morphologic and functional changes take place in pathogenic bacteria by their passage through animals, and if the altered form confronts us and we are without knowledge of the conditions which wrought the change, it is often very difficult or impossible to trace it back to its origin. Such retrospective examination is frequently valueless, but it is of the greatest importance when, for instance, our purpose is to discover immunizing substances against disease germs upon the principle of Jenner's vaccine.

After these general preliminary remarks, the author proceeds to sketch his position in regard to the study of Koch's bacillus and of other bacilli which resemble it.

Koch's tubercle bacilli, *TbI*, can not be differentiated morphologically or culturally from tubercle bacilli which cause tuberculosis in cattle, *TbII*. In the diseased products of swine, goats, dogs, rabbits, guinea pigs and other mammalia which become tuberculous without intentional infection on our part, we rarely fail to find tubercle bacilli which differ in no wise from *TbI*. Also pure cultures of bacilli from these sources resemble so very closely pure cultures of *TbI*, that, until Koch's announcement before the London Congress, we felt justified in accepting aetiologically a group of mammalian tubercloses with a common, identical, specific cause, the tubercle bacillus of mammalia.

Comparison of mammalian tubercle bacilli with the acid proof bacilli

found in tuberculous fowls has shown material differences, and likewise comparative dissimilarity has been noted in the bacilli found in cold blooded animals, particularly fish.

Behring now states his experience in regard to the phylogeny of two forms of tubercle bacilli from fowls (*HTb.*) which morphologically and culturally differ from *TbI.*, and after referring to the morphologic transformation of mammalian tubercle bacilli into the characteristic avian form which was first accomplished by Nocard, says he is in the position to prove the identity in kind of avian tubercle bacilli with tubercle bacilli from bovine sources by experiments made together with Dr. Römer.

The *HTb.* which were employed in these experiments and which have been in the author's possession for a year, originated from two hens which were obtained from a neighboring estate in a quite sick condition. Upon this estate bovine tuberculosis had been very prevalent. Two years ago forty chickens fed upon the entrails of a tuberculous cow which had been butchered, the entrails having been left in the yard. Three months later a few of the chickens became sick and died. More died in the next four months and two years later all had died but two which were sick. Examination of these showed that both suffered from tuberculosis and pure cultures were obtained from them which presented the usual morphologic characteristics of avian tubercle bacilli, but showed approximately the same pathogenic power for guinea pigs, rabbits, and cattle.

The history of these avian tubercle bacilli, as well as their virulence for mammalia, speaks for their origin from tuberculous cattle which existed upon the estate. As an additional and if possible stronger evidence for this conclusion stand the facts that cattle which had been immunized against bovine tubercle bacilli proved also immune to the tubercle bacilli obtained from these fowls, and that these particular bacilli can be used for immunizing cattle against bovine tuberculosis.

Although these bacilli materially differ in cultural properties and likewise show marked variance in the anatomical lesions produced in cattle, as compared with *TbII.*, von Behring feels fully justified in insisting that they have a common source with *Tb. II.*, and in considering them a sub-variety of bovine tubercle bacilli, he accordingly designates them as *TbIIa.*

Inasmuch as fowls may acquire tuberculosis from cattle, they can probably also acquire it from the ingestion of human sputum and in this connection von Behring expresses the suspicion that the tubercle bacilli

of fowls which are but slightly virulent for mammalia, especially guinea pigs, are a sub-variety of human tubercle bacilli (*TbI*).

Arloing and his students have shown with absolute certainty that cultures of human tubercle bacilli may be so modified that they very much resemble von Behring's *TbIIa* and are likewise but slightly virulent for guinea pigs. The author finds that the differences which exist between human tubercle bacilli and bovine tubercle bacilli are much less than those between human bacilli and Arloing's modification of the latter; further that there are human tubercle bacilli which are but very slightly virulent for cattle and others which equal and even exceed the virulence of some bacilli of bovine origin; moreover he has every reason to assert that bovine tubercle bacilli represent in general a greater degree of virulence and that *ceteris paribus* they are more virulent to man than are tubercle bacilli from a human source.

For practical purposes the proposition *homo homini lupus* may stand, not because bovine is less virulent than human tuberculosis, but because the opportunity for human infection with bovine virus can only obtain under special conditions.

On the other hand it has been urged, considering the wide distribution of bovine tuberculosis and the not very rigorously enforced measures against tuberculous food products derived from cattle, that intestinal tuberculosis should be a much more frequent finding in the post-mortem examination of human subjects. In this connection the author calls attention to the statistics recently published by Heller which show that in the cities of Keil and Boston intestinal tuberculosis was found to be coëxistent in 37 per cent. of children who died of diphtheria.

It is generally admitted that intestinal tuberculosis is relatively infrequent in adults. Is this not strange and is not a particular explanation necessary for this observation when we consider the great number of people who suffer from pulmonary tuberculosis and who doubtless constantly swallow tubercle bacilli with their saliva and are thus liable to intestinal infection?

Without entering into a detailed discussion of various minor factors which may bear upon this question Behring selects one factor which in his opinion is of the greatest significance, and which also plays an important rôle in the question of bovine tuberculosis as well. This is the normal condition of the intestinal mucous membrane of the newborn in which the mucous zone is not as fully developed as in the adult. According to Prof. Disse the epithelial cells of the intestinal mucous membrane in the newborn are almost entirely protoplasmic, show no large nuclei

and are sharply limited toward the lumen. The glands are still very short. Not until a few days after birth are the free ends of the cells able to take the mucicarmin stain and then only at isolated points. The formation of mucus occurs only in localized areas and, in the beginning, is limited to the upper layer of cell protoplasm. At the time when a continuous and well marked mucous zone and an ample secretion of mucus is still absent the intestinal tract is permeable for many things which cannot pass later, except after injury of the mucous membrane. Anti-toxic albuminous substances when given by the stomach are in the newborn as readily resorbed as though they were injected directly into the circulation or subcutaneously, whereas it is well known that the adult organism is entirely incapable of absorbing such substances under normal conditions, either through the stomach or through the rectum.

The significance of the foregoing in the question of infection by tuberculous food products is self-evident: By reason of the layer of mucous cells covering the intestinal surface and by the active secretion of mucus, adult individuals are protected against the entrance of tubercle bacilli; the newborn and young children, however, are highly susceptible to infection when, for instance, they are fed with milk containing tubercle bacilli. This applies to cattle as well as to man and this is the reason why intestinal tuberculosis is found with such frequency in calves. Such an intestinal infection is doubtless capable of spontaneous recovery, but it is the author's impression that additional infection of young cattle in later periods of life, leads more readily to disease of the mediastinal and bronchial glands, and finally to pulmonary tuberculosis, than in animals which were not already infected at an earlier age.

Prof. von Behring now presents a table showing the relative frequency of bovine tuberculosis in the districts adjoining Marburg in different breeds of cattle according to the size of the herd and according to the age of individual animals thereof. Regarding the influence of age on the frequency of tuberculosis in man Behring refers to the statistics of Naegeli who thinks that he has shown tuberculosis to be more prevalent in advancing years than seems to be the case with cattle. That this is rather apparent than real is indicated by the report of Bang who says: "When tuberculosis has been prevalent for years in a large herd, the tuberculin test may usually be omitted in adult animals, because almost all of them will react even if they are apparently healthy. Experience has shown me that of the few non-reacting animals the majority is nevertheless not entirely free from the disease. Cattle which have for several years been exposed by association with infected animals usually harbor

tubercle bacilli within their bodies in a few small, old, tuberculous nodules which exist principally in the bronchial or mediastinal glands. To this class belong most of those in which, as stated before, the tuberculin test is negative. Although such animals are not, as a rule, a source of danger, a liability of further development of the tuberculous process nevertheless exists; for this reason they should not be kept with healthy animals, and in large herds only the non-reacting calves and younger animals should be assigned to the division of healthy animals. In small herds I usually recommend that all animals be tested with tuberculin".

Behring calls attention to an apparent exception to the rule, in a certain breed tabulated by him, that tuberculosis in cattle occurs with increasing frequency as age advances, and offers as an explanation the fact that these particular cattle have been only recently contaminated by the importation of tuberculous stock into the herd. He thinks, therefore, that before that time there was no opportunity for infection of the younger animals, and that infection of adult animals occurred less frequently, because an inherited disposition to the contraction of tuberculosis did not exist. On several occasions he observed, postmortem in such animals which he had subjected to his method of immunization "inactive, latent tuberculosis" which did not interfere with their health. The prevalence of tuberculosis in this particular breed of cattle is, however, on the increase, and in several localities the difference above referred to is no longer apparent.

The frequency of tuberculosis in man Behring believes to be governed by like influences. For example, the apparent immunity observed at elevated climatic resorts disappears after tuberculous individuals have frequented these localities for a long time, and more particularly when tuberculous mothers become members of the resident population and transmit with their milk tubercle bacilli to their descendants. Like infected calves so the children may appear in good health until, with the physiologic changes at puberty or with the advent of intercurrent disease, colds, injuries, etc., the latent tuberculosis of lymphatic glands is aroused to activity without any exact knowledge on our part as to when and where the primary infection has taken place. While it is possible that additional infections which occurred at a later period exerted an influence upon the actual manifestations of the disease, this is not a necessary condition, and it is readily conceivable that an infection which at first induced only a clinically latent, local process may extend through the circulation by auto-infection to an injured joint or to a lung which was temporarily especially disposed to tuberculosis.

Returning to the question of transmission of tuberculosis from cattle to man, the author says that the preceding elucidation should explain why he does not attach much importance to the danger of infection from food-products derived from tuberculous cattle, for such foods are chiefly consumed by adults whose intestinal apparatus is sufficiently protected against the comparatively small number of tubercle bacilli thus taken in. He sees, however, some justification in the popular belief that scrofulous skin affections of children stand in relation to a free consumption of butter; but the danger to nurslings from tuberculous milk, whether from cows or from tuberculous mothers, can scarcely be overestimated.

That infection of human beings from cattle be clearly proved, it has been demanded that all other modes of infection be strictly excluded; it has also been exacted that if tuberculous milk be held responsible for the occurrence of tuberculosis in one individual it must be shown that all others who have drunk milk from the same source did likewise contract the disease. "In this respect," says Behring, "let similar conditions be demanded for the proof that human beings have become tuberculous through the inhalation of dust containing tubercle bacilli or of Flügge's droplets, or through infection with material containing tubercle bacilli which has accumulated under the finger-nails, and let it then not be forgotten that for centuries there have been those who denied the communicability of tuberculosis from man to man, and that our present teaching in regard to epidemiologic transmission is after all more a matter of belief than of actually demonstrated knowledge."

HISTOLOGICAL CHANGES FOLLOWING THE INJECTION OF DEAD TUBERCLE BACILLI.

At the request of Prof. Fraenkel, Director of the Hygienic Institute of the University of Halle, Engelhardt carried out a series of animal experiments with the object of again determining the histologic changes which follow the injection of dead tubercle bacilli into the tissues. The results of his experiments he reports in the *Zeitschrift für Hygiene u. Infektionskrankheiten*, XLI, 2, p. 245.

Engelhardt accepts as sufficiently proven the fact that dead tubercle bacilli can produce tubercles in the tissues which histologically are identical with true infectious tubercles. His own investigations were chiefly devoted, to the determination of the question whether, as Gameleia has claimed, caseation occurs in tubercles caused by dead tubercle bacilli, or as asserted by Prudden, Hoenpfl and Keller, such tubercles differed in

the non-occurrence of caseation from those induced by the action of the living bacillus of Koch.

Baumgarten, in whose institute Keller's experiments were made, regards tubercles caused by dead tubercle bacilli as due simply to the effect of foreign bodies which can result from a variety of indifferent foreign substances, and, therefore, incapable of undergoing caseation.

The author's results show that the structure of such tubercles, in respect to cellular elements, is exactly the same as that of true tubercle. Typical giant cells were observed, but it seemed probable that the formation of the tubercle was slower. On intravenous injection of dead tubercle bacilli he found cellular proliferation in the intima of blood vessels which he attributed to their irritating effect. The latter he holds to be due chiefly to a chemical rather than to a mechanical action for two reasons:

1. On account of destructive changes observed in the elastic fibres where dead tubercle bacilli become lodged.

2. Because of the occurrence of desquamative pneumonic changes which, however, were noted in only one of the animals.

Concerning the retrogressive changes of such tubercle the author observed signs of necrosis of the cells after the eightieth day, but never the occurrence of fibrinous substance demonstrable by color reaction and, therefore, never even the slightest indication of a beginning caseation.

EDITORIAL.

ON THE RELATION OF HUMAN AND BOVINE TUBERCULOSIS.

In the present number of the *Journal* will be found full abstracts and translations of several communications to this subject. Since Professor Koch announced his two propositions at the London Congress of Tuberculosis in 1901, numerous investigators and students of tuberculosis have sought to establish the error of his views. A large number of experiments have been recorded in the literature which have been claimed to prove the identity of the bacilli of human tuberculosis with those of pearl disease, as well as the successful inoculation of cattle with tubercle bacilli of human origin.

The investigations of Villemin which led that authority to conclude that tuberculosis was of an infectious nature and transmitted through the agency of a specific virus, gave rise to a multitude of experiments by others who, from their results, opposed Villemin and asserted that tubercle was in no sense a specific product, but was merely the effect of inflammatory processes. Indeed, until the discovery of the tubercle bacillus and the demonstration of its specific etiological relation to tuberculosis the view of the opponents of Villemin was that most generally accepted. This opinion was held, because by the introduction of all sorts of material tubercles were produced in experiment animals which not only anatomically but histologically appeared identical with true tubercle and also often underwent caseation.

In many of these experiments wholly indifferent substances such as lycopodium, cinnabar, metallic mercury, powdered cork and sponge were employed, while in others particles of normal tissue, carcinomatous and sarcomatous tissue were used. In still others tuberculous human tissue which had been preserved for a long time in strong alcohol and which immediately prior to introduction had been thoroughly boiled in alcohol

was inoculated. From facts since established it is reasonable to presume that the tubercle bacilli contained in such tissue had been rendered innocuous. In some instances inoculation of tuberculous tissue which had been thus treated resulted in the production of characteristic, pedunculated pearl nodules upon serous membranes of experiment animals. Again, in numerous cases not only were processes such as have been mentioned engendered by indifferent substances, but frequently the death of the animal resulted from pseudotuberculosis which most closely simulated the true disease.

In these experiments all the various modes of infection were resorted to which have been employed in the recent investigations as to the relation of human tuberculosis and pearl disease.

If now we critically examine the data of the numerous animal experiments which have been undertaken to disprove Koch and in which success is claimed in the transmission of human tuberculosis to cattle we are strongly reminded of the experimental investigations, which preceded the discovery of the tubercle bacillus, and two important considerations become at once apparent:

1. By the inoculation of animals with indifferent substances by the contemporaries of Villemin in their endeavors to negate the theory of the specific nature of tubercle, lesions were produced which in minute detail correspond to those which have resulted from the inoculation of cattle with human tubercle bacilli and which are now being claimed to prove the error of Koch's position.

2. In all of the experiments in which positive results in the transmission of human tuberculosis to cattle are claimed, there is not one which is entirely free from objection, for not only have the methods employed, been more or less faulty, but natural conditions have not been complied with.

In the light of the facts established in Villemin's time it appears evident that with tubercle bacilli which are known to be dead, anatomic and histologic tubercles may be produced. In fact in more recent years this has been proven by the work of Prudden and Hodenpyl, Abel, Straus and Gamaleia and others. Consequently the production of anat-

mic and histologic tubercle in cattle by the inoculation of human tubercle bacilli does not prove the identity of the human and bovine germ nor does it demonstrate the possibility of the transmission of human tuberculosis to the bovine species.

In an article in the current number of the *Journal* Professor Baumgarten has aptly called attention to the objections to intraperitoneal and intravenous methods of inoculation as well as those of subcutaneous injection of large amounts of suspensions of tubercle bacilli into the neck.

Until it is proven that tuberculosis is produced in human beings by food products of tuberculous cattle, the question of the transmission of human tuberculosis to cattle can have only an economic bearing. If the communicability of human tuberculosis to cattle were demonstrated, the reverse proposition would also still require proof; and inasmuch as experiments upon human beings are not available we could at most reason by analogy, that if human tuberculosis is a source of danger for cattle, then bovine tuberculosis may be a source of danger to man. But man is subjected to the danger of contracting tuberculosis from cattle only under natural conditions, as by ingestion, accidental inoculation of the skin or inhalation. If, therefore, we wish to show the liability of cattle to contract tuberculosis from the human subject, either because of the economic bearing of this question upon the protection of dairy herds from human sources of infection, or because from results of experiments we wish to reason by analogy that the tuberculous food products of cattle constitute a menace for man, then artificial infections are not necessary. On the contrary it would need to be shown that the ingestion or inhalation of tuberculous discharges from human beings, or the accidental inoculation of the skin, can and does cause tuberculosis in cattle under purely natural conditions.

For such an experiment the cattle should, in the first place, be selected from a healthy herd and should, immediately prior to the inauguration of the experiment, be carefully tested with tuberculin. Since it is well known that cattle are highly susceptible to bovine tuberculosis, every possibility of a source of infection with bovine bacilli should be absolutely excluded. To this end the experiment animals should be placed in quarters

immediately after negative results of the tuberculin test, in which no other animals are kept and in which no cattle which may have had bovine tuberculosis had been previously stabled. As an attendant should be chosen a phthisical subject in the "open state", in whose expectoration tubercle bacilli had been demonstrated and he should be instructed to seek by a careless disposition of his sputum to infect the experiment animals. The attendant should further not be permitted to come in contact with any other cattle which are not proven by the tuberculin test to be free from pearl disease.

That such experiments would result negatively the writer is inclined to believe from a consideration of the artificial experiments which have already been made, and in which nothing more than a non-progressive tuberculous affection has been produced in cattle by inoculation with human tuberculous material.

Quite recently Prof. Schottelius has made a preliminary report of a feeding experiment which he considers to have been conducted under natural conditions, and in which he obtained an apparently positive result (an abstract of this paper appears in another part of the *Journal*). Altogether each animal received 1200 c. c. of human tuberculous sputum mixed with its food in amounts of 50 c. c. at a time. Only in a grown cow and not in the calves does the author mention the induction of an enteritis which he terms tuberculous. To the writer it seems scarcely creditable that cattle should, under natural conditions, receive mixed with their food, human tuberculous sputum in such excessive amounts. Neither is it remarkable that an enteritis followed the ingestion of such amounts of a decomposing, acrid, organic product which, in all probability, contained, besides tubercle bacilli, other pathogenic microorganisms as phthisical sputum usually does. That such other pathogenic germs as may have been contained in the sputum fed to these cattle, might readily have gained entrance into the lymphatics and even into the blood, with the production of lesions such as were the majority of those described by Schottelius, is not impossible and seems not improbable. The demonstration of tubercle bacilli in the affected parts is of no consequence, for dead tubercle bacilli which have been stained for purposes of sub-

sequent identification have been found in the tubercles in animals in which pseudotuberculosis has been caused by their agency.

Altogether, by the evidence thus far adduced, the possibility of experimentally transmitting human tuberculosis to cattle cannot be accepted as proven and Koch's first proposition, in which he is confirmed by the work of Baumgarten, Möller, Frothingham, W. H. Park, and R. J. Wilson and others, remains still unrefutable.

The second proposition of Koch, relating to the transmission of bovine tuberculosis to man, is by all odds the most important consideration. While medical literature abounds in cases in which the clinical evidence seems to indicate a more or less direct relation between tuberculous disease in man and infection with tuberculous food products, from cattle, the proof is still lacking. In such cases it is often quite impossible to entirely exclude a previous or subsequent human source of infection. Furthermore that dependence on clinical evidence alone is liable to lead to erroneous deductions is manifestly true, as amply illustrated by the cases reported by Ollivier.

It is generally admitted that the bovine tubercle bacillus, by accidental inoculation, is capable of producing local lesions of the skin in man and not a few instances of such occurrence have been recorded. In not a single one of these cases, however, has an extension of the tuberculous process to distant parts or internal organs been shown to stand in relation to such an infection. On the other hand numerous cases have been reported in which accidental cutaneous inoculation of human beings with tuberculous human discharges stood unmistakably in relation to the death of the individual from generalized tuberculosis.

As positive evidence of the non-communicability of bovine tuberculosis to man exist the now well-known bacterio-therapeutic experiments made in Königsberg, in which human beings who suffered with inoperable malignant disease were inoculated with bovine tubercle bacilli with negative results.

The theory of antagonism between carcinoma and tuberculosis upon which these experiments were undertaken, has long since been disproved and cannot be offered as an objection to the negative results obtained.

While the latter are not to be accepted unconditionally as proof of the non-communicability of bovine tuberculosis to man, they are at least suggestive that the actual danger to human beings from the tuberculosis of cattle, is, as Koch believes, an insignificant one.

In a previous editorial (Vol. II, 1900, p. 67,) the varieties of the tubercle bacillus have been dealt with, and the theory of adaptation to environment has been advanced as sufficient to account for all the differences which have been observed in the human, bovine, avian and piscine forms. It is a well established fact in bacteriology that exaltation or attenuation in virulence as well as modifications in morphologic and cultural properties of various pathogenic microorganisms can be produced at will by laboratory procedure. In other words such differences can be induced by artificial change of environment. That this law is applicable to the tubercle bacillus is reasonable to suppose, and the work of Nocard who so modified human tubercle bacilli as to render them infectious for fowls, and also the more recent observations of von Behring, would seem to contribute evidence for the confirmation of such a theory. It is but a step further to the supposition that, if artificial change of environment is capable of so modifying in all respects varieties of tubercle bacilli, also in adaptation to gradually changing environment in nature we may seek an explanation for the origin from a parent stem of the various forms of the tubercle bacillus as they are now known, each of which appears to have acquired a selective activity for particular species of animals. If this were in fact the case there should be no occasion for alarm on the ground that reversions or modifications are liable to occur by which the tuberculosis of man, cattle, birds and fish might become intercommunicable. The adaptation and selection of species, varieties and sub-varieties is in nature undoubtedly the result of influences which have been operative over vast periods of times, and there is certainly no reason to believe that retrovertive changes would occur with greater rapidity. Indeed if owing to peculiar conditions changes might occur by which in an individual case man might become infected with the tuberculosis of cattle for example, this could be looked upon only as most exceptional.

It is true that the question of the intercommunicability of human

tuberculosis and pearl disease cannot be decided by the evidence thus far adduced. It is not proven that the tuberculosis of man is a source of danger to the bovine species, nor is it demonstrated that bovine tuberculosis constitutes a menace to human beings. However it is sufficiently well established that tuberculosis is readily transmissible from man to man and that in man himself is to be sought the greatest element of danger of the propagation of tuberculosis in the human race. Therefore, inasmuch as the means at our disposal are by far inadequate for the establishment of ideal prophylactic measures against a danger which is known to exist, it would seem most rational to seek thoroughly to protect ourselves against this first. Should means be appropriated in excess of this requirement it will be time enough to advocate provisions for protection from evils which are unknown and the existence of which has not been proven and still remain, to say the least, exceedingly doubtful.

PRIZE ESSAYS.

The two prizes of a thousand dollars and five hundred dollars which were offered last January by the Maltine Company for the two best essays on Preventative Medicine have been awarded, the first to Dr. W. Wayne Babcock, of Philadelphia, his subject being "The General Principles of Preventative Medicine," and the second to Dr. Lewis S. Somers, also of Philadelphia, whose essay was entitled "The Medical Inspection of Schools—A Problem in Preventative Medicine." The two successful essays will first be published in representative medical journals and then in permanent form for gratuitous distribution to the profession at large.

ORIGINAL CONTRIBUTIONS.

PULMONARY TUBERCULOSIS.*

BY GEH. SANITÄTSRATH DR. AUFRECHT, MAGDEBURG,

Physician-in-Chief to the Internal Division of the Altstädterkrankenhaus.

I. THE PATHOGENESIS OF TUBERCULOSIS.

Since the discovery of the tubercle bacillus by Koch, the researches into the histological changes brought about by tuberculous disease, and especially into those of lung-tissue, have remained wholly in abeyance. As all pathological processes were attributed to the action of the tubercle bacillus, it seemed of no import to make still further inquiries concerning the tissue elements upon which, or in which, the bacillus exerts its pathogenic effect. Among others, ZIEGLER¹, says: "Tuberculosis is an infectious disease caused by a fungus, and especially characterized, anatomically, by the formation of cellular nodules, of which part undergo coagulation necrosis, and part are transformed into connective tissue. These cellular nodules which are known as tubercles, represent a circumscribed non-vascular area of exuberant granulation-tissue whose peculiarity depends upon the specific action of the disease-exciting agent. They occur mainly as well-circumscribed gray and white nodules in tissues which seem otherwise scarcely or not at all altered, but also in tissues which bear the marks of a diffused inflammatory disease, or else they represent only discrete and more or less distinctly definable foci within larger masses of exuberant granulations. Occasionally these exuberances occur also in the form of large tumor-like nodes, well-defined in relation to the surrounding tissue."

With regard to pulmonary tuberculosis it seems to be a settled fact that the tubercle bacillus is inhaled, and reaches the smaller bronchi or alveoli, where it produces its deleterious effect upon the hitherto histologically normal tissue. With this view, however, I have not been able to bring my clinical observations into accord. Despite the intimate intercourse of phthisical patients with other non-consumptive patients, such

* Translated for the *Journal of Tuberculosis* from the author's manuscript.

¹ ZIEGLER: Article on Tuberculosis in Eulenburg's Encyclopedia, 3rd edition, vol. 24, p. 598

as existed in the hospital under my charge, as well as in all others, before the discovery of the tubercle bacillus, despite the then prevalent neglect of disinfection of tuberculous sputa, I have never observed a case which would have justified me in the presumption that the disease was caused by the inhalation of the harmful organism. Even to the present day, and despite close objective observations, I have not seen a single case in which even the suspicion that the disease was caused by inhalation of tubercle bacilli could be entertained. I have seen two patients with *tabes dorsalis* and four patients with multiple sclerosis lie side by side with consumptive patients, for from three to eight years, without becoming infected. One patient who suffered with adhesive pericarditis, and who formed a close friendship with his consumptive neighbor, passed him everything, shared his food with him, and made his bed for two years, was, after his death, found free of any tuberculous disease.

A strong argument against infectiousness is among others brought out by KELSCH¹, who says: "At no time has as much been done for the hygiene of armies as in recent years; no other class of the population has, perhaps, received so much benefit from the progress of which prophylactic science is so proud. Tuberculous soldiers are segregated at the earliest suspicion of their disease, the armories are disinfected regularly and methodically by the most rational and effective means, and in the hospitals the virulent excreta are destroyed. This is carried out in all European armies, and yet tuberculosis is not on the decrease, as the official statistics of the last seventy-five years show. On the contrary, it is on the increase, just as if its frequency were proportionate to the more arduous duties which are imposed upon armies in active service, so as to complete their education in military science in the shortest possible time. Is this not a positive, although an indirect proof that infection is made responsible at least in part for the conditions which preëxisted in the individual before entrance into the army? Tuberculosis is brought into the military service in a latent state in the lung, or as a glandular focus which may be situated in the most concealed portions of the body. A powerful constitution and evidence of good health by no means preclude the existence of such hidden lesions which manifest themselves sooner or later on occasions of disturbance of the general health, and lead to secondary infections which bring about a pleurisy, a bronchitis, a phthisis or a miliary tuberculosis.

In favor of the origin of the disease by inhalation of bacilli, the sta-

¹ KELSCH quotes from Straus: *La Tuberculose et son bacille*, Paris, 1895, pp. 453, 470.

tistics of CORNET¹, regarding the great mortality of nurses intrusted with the care of consumptive patients, were adduced as particularly valuable evidence. In agreement with the scientific tendency, the results of these statistics were generally accepted, and contrary opinions, expressed by experienced physicians (Humphry, Fürbringer, Ewald, Haupt) were practically ignored.

My statistical results likewise have given me no ground for the theory of the infectiousness of the disease by inhalation. As I have elsewhere stated, 34,560 patients were received into the Altstädterkrankenhaus of this city, in the internal division under my charge, from January 1, 1880, to March 31, 1897. Among these there were 3820 suffering from pulmonary tuberculosis, mostly in an advanced stage as is shown by the number of deaths, which were 1630. With all these patients the male and female nurses came into intimate contact. The number of these, according to an official computation made for the purpose, was 263, of whom 124 were male and 139 female nurses. Of these, there had been on duty:

| | Male Nurses. | Female Nurses. | Total. |
|-----------------------------------|--------------|----------------|--------|
| Less than 3 months, - - - | 28 | 13 | 41 |
| " " 6 " - - - | 27 | 19 | 46 |
| ½ to 1 year, - - - | 22 | 25 | 47 |
| 1 to 2 years, - - - | 27 | 32 | 59 |
| 2 to 5 years, - - - | 12 | 36 | 48 |
| 5 to 10 years, - - - | 7 | 9 | 16 |
| 10 to 15 years, - - - | 1 | 2 | 3 |
| 23, 24, 27 years, respectively, - | .. | 3 | 3 |
| | <hr/> | <hr/> | <hr/> |
| | 124 | 139 | 263 |

Of all these, only one female nurse, after five years' service, infected herself while attending a typhus patient, and died. Two male nurses contracted typhoid fever and one other contracted tetanus from a patient whose disease occurred after crushing of the toes from a horse's kick. These three male nurses recovered. With regard to all the 263 attendants I must record the greatly surprising fact that in not a single one did pulmonary or any other form of tuberculosis occur; also that there was no pathological condition present which would have suggested even the suspicion of tuberculous disease. But this is not enough. Further experience has taught me that a firm foundation is wanting for Cornet's statistics which can only be supplied by exact determination of the state of health of the nurses at their entrance upon their nursing duties. If such

¹ CORNET: Tuberculosis, Northnagel's Specielle Pathologie and Therapie, vol. 14, part 3, p. 226.

a determination be made, as it was by me, then quite different results are shown.

In the Altstädterkrankenhaus of this city, the employment of paid nurses coming from the lower classes was discontinued by the municipal authorities in October, 1898, and the chief physicians both of the external and internal divisions were authorized to train women and girls of the better class, as nurses. For the internal division conducted by me I accepted the applicants who, with two exceptions, declared that they had previously always had healthy respiratory organs, without physicians' certificates of health. These exceptions related, first to a pupil nurse who five years before had survived a severe hæmorrhage with consequent serious disease of the lungs, but at the time of admission into the training-school showed no objectively demonstrable changes at the apices of the lungs. The second case was one who a year before had been treated by me for hæmoptysis with consequent extensive infiltration of the right upper lobe, but who at the time of her admission into the training-school had only a very slight consolidation of the same apex. Every one of the pupil nurses to be accepted was carefully examined by myself as to the state of her health. This examination showed that of 49 pupils, in no less than 29, pathological changes were demonstrable in the right or in both apices. Only the first case mentioned above had to be discharged, on account of renewed hæmoptysis with consequent lung involvement. Among the rest, after from six to nine months' duty among consumptive patients (on December 18, 1899, there were 28 consumptives out of 200 patients) there was no change for the worse.

After this determination of the actual facts, can it still be asserted that, as regards nurses, infection in hospitals influences the occurrence of pulmonary phthisis?

Next, another seemingly convincing proof for the origin of human pulmonary tuberculosis by the inhalation of tubercle bacilli should be more closely examined: namely, that of animal experimentation. There can be no doubt that one can produce tuberculosis in animals that are made to inhale pulverized masses containing tubercle bacilli, or pure cultures of bacilli, but on closer investigation it became apparent that the results of such inhalation-experiments are not at all available for interpretation of the processes as they occur in the human subject.

First, we must emphasize the fact that there is scarcely an organism which offers less resistance to the multiplication and general dissemination of the tubercle bacillus than that of the guinea-pig and that of the rabbit, which animals are mostly used for such experiments. It may be

regarded as a general rule that in these animals an inoculation with tubercle bacilli never remains localized, but always leads to general tuberculosis. In man, on the contrary, localized tuberculosis very frequently remains as such, no matter whether it be lupus, or "anatomical tubercle," acquired in dissection of tuberculous bodies, or the tuberculous inflammation of a joint.

The remarkable susceptibility of the rabbit (and of the guinea-pig which I did not use in my rather numerous experiments) to the tubercle bacillus, explains the fact that after the discovery by Villenin of the communicability of tuberculosis to animals, and before the discovery of the tubercle bacillus by Koch, a great number of authors believed themselves able to produce tuberculosis in rabbits with non-tuberculous materials also. In such cases the point involved is doubtless that there was an admixture of tubercle bacilli in the seemingly non-tuberculous inoculation material. Two years ago I made experiments on transmission of a carcinoma of the mamma with two rabbits, in which the carcinomatous substance, obtained by rubbing up in water, was injected into a vein of the ear with a perfectly new Pravaz syringe. The tubercles found, after three months, in the lungs, the diaphragm, and the liver contained as many tubercle bacilli as if these had been injected in pure culture. This is certainly a proof that, despite all precautions (perhaps in consequence of the sojourn of such animals in quarters that may not have been free from tubercle bacilli) the most widely spread tuberculous infection can take place. On the other hand, it is also remarkable that in those upon which no experiment was performed, no infection took place, despite their living together with tuberculous rabbits. Such an experience with regard to the development of tuberculosis in rabbits, after intravenous injection of pure carcinomatous material, places the results of similar experiments in which rabbits are used as a reagent for tuberculosis in a very doubtful light. I for my part would not, after this, declare that a material is tuberculous, or, more correctly, contains the exciting agent of tuberculosis, if no other proof can be brought therefor than that inoculation into rabbits or guinea-pigs gave positive results.

Besides this high degree of susceptibility of rabbits to the tubercle bacillus, no matter where the first place of its invasion is, a number of additional reasons can still be adduced, which render the results of inhalation-experiments on animals inadmissible in their application to man. In man it is not a question of intentional inhalation of dust or fluids containing tubercle bacilli in great numbers; but only of the accidental inhalation of a single bacillus that can enter into consideration. That such bacilli can

reach the finer bronchioles, or even the alveoli, is not only entirely without proof, but, on the contrary, after the convincing studies of SÆNGER,¹ such an occurrence is wholly excluded. The bacilli remain adherent to the walls of the larger bronchi in which, as he correctly states, primary tuberculosis is exceedingly rare or, in fact, does not occur at all, as is the case with primary tuberculosis of the nose, of the fauces, the larynx or the trachea.

Of how little value inhalation-experiments on animals are for the assumption that man acquires pulmonary tuberculosis through inhalation, and how slight the justification is for using these as proof for this assumption, is shown by the difference, likewise emphasized by Sænger, between what occurs in experimental-inhalation of dusty masses or of fluids which contain the materials concerned, in suspension, and in inhalation of very small dust-like particles, such as can occur in man, as far as concerns the inhalation of tubercle bacilli. It is not the dust that in itself forces its way to the alveoli; it is only sucked into the alveoli with the fluid inhaled, or with the secretion obtained from the bronchial mucous membrane by irritating it. While in animal experiments such an aspiration is evident, it may be regarded as practically excluded as far as concerns the inhalation of single tubercle bacilli into human lungs.

Finally, the fact must be taken into consideration, that the inhalation tuberculosis of animals does not in any way correspond to chronic apical tuberculosis. In the former, the disease extends over the whole lung. An exclusive involvement or main participation of the apex is never observed.

The same view is expressed by RIBBERT² in these words: "One ordinarily imagines that the lungs become diseased through a direct ærogenic infection, independently of an older focus. But on thorough investigation this assumption is totally lacking in sufficient proof. It is, indeed, true that pulmonary tuberculosis can be produced in animals by inhalation of pulverized bacilli, but the disease so originating does not at all correspond to human tuberculosis, and such an experiment does not prove that the infection in man results in the same way. The conditions under which he inhales tubercle bacilli are, especially as regards quantity, essentially different from those prevailing in inhalation-experiments.

¹ SÆNGER: Zur Ätiologie der Lungentuberkulose. *Virchow's Archiv*, 1901, Bd. 167, S. 116.

² RIBBERT: Ueber die Ausbreitung der Tuberkulose im Tierkörper. Universitätsprogramm, Marburg, 1900.

BAUMGARTEN¹ also declares: "The inhalation theory of human tuberculosis stands on such a weak footing that not even in a single case of this disease has positive proof been furnished that it was really brought about by natural inhalation of the specific bacillus. The possibility of such an origin of pulmonary tuberculosis is, of course, not to be denied, but the now prevalent assumption that it is the usual, or indeed the practically exclusive one, must be regarded as unproved and as very doubtful."

From all these statements it appears that opinions concerning infection of healthy people through contact with consumptives, or by the inhalation of tubercle bacilli, differ greatly and cannot be admitted as proving it with any degree of certainty, and likewise that the results of inhalation-experiments on animals are not admissible in studying the origin of the disease in man.

If we further take into consideration the facts that tubercle bacilli have indeed been found in the nasal fossa of man² without having caused any morbid change, that they have never been found in the air-passages of healthy lungs, and that there exist no anatomical researches whatever into what occurs at their first entrance into the finer bronchioles and alveoli from which, by general agreement, the tuberculous process is supposed to start, then my steadily entertained purpose, thoroughly to investigate the very earliest changes in the apices of the lungs, for the purpose of an inquiry, as objective as possible, into the beginning of the disease, in order to determine the relations of the tubercle bacillus to the beginning of anatomical changes, ought from the outset to be acknowledged as an essential one to the elucidation of the subject.

But here I must first admit that I was not at all prepared for results which would guide the doctrine of the origin and course of pulmonary tuberculosis into entirely different channels from those previously taken. I even started the investigations with the preconceived notion that bacilli are inhaled. I hoped only to be able to verify my conviction that the inhaled bacilli could not injure healthy lung-tissue and that consequently a direct infection by inhalation of tubercle bacilli does not exist. I was really concerned only in finding a positive basis for my suspicion that in the apices of the lungs *a priori* anatomical changes of slight degree exist, which furnish a suitable soil for the growth of the tubercle bacillus. If I have now arrived at totally different results these should at least be regarded as having been reached without any prejudice.

¹ BAUMGARTEN: Ueber experimentelle Lungenphthise. Verhandlungen der deutschen pathologischen Gesellschaft, 4 Tagung, Berlin, 1902, p. 76.

² Cf. STRAUS: La Tuberculose et son bacille, Paris, 1895, p. 587.

There is an actual difficulty in the way of examining the very earliest changes and that is the comparatively rare discovery of small solitary foci in the apex of a lung otherwise intact. Such a discovery is of course only possible in persons that have died of non-tuberculous disease. But one can make a considerable number of autopsies without meeting these early changes spoken of. If, despite my steadily pursued examinations of such isolated findings in the course of my many years' hospital work, I had not heretofore arrived at definite conclusions this was due to my insufficient experience in the interpretation of microscopic changes in lung-tissue in other, i. e., in non-tuberculous lung-diseases. Only the investigation, pursued for several years, of all inflammatory changes in lung-tissue, the main results of which I have reported in my essay on inflammations of the lungs,¹ afforded me the foundation for a better understanding and for correct interpretation of the local changes taking place at the beginning of pulmonary tuberculosis. But not least of all has the use of the Biondi-Heidenhain (not the Biondi-Heidenhain-Ehrlich) stain stood me in good stead. The diseased parts of lungs in walnut-sized pieces were hardened for about eight days in frequently changed five per cent. potassium bichromate solution, and thereafter in alcohol. Pieces a few millimetres thick were then affixed to cork with fish-glue, by dipping in absolute alcohol for from three to six days, when sections were prepared with the microtome. I placed these for ten minutes in the undiluted Biondi-Heidenhain triple stain, washed them off in alcohol, water, and alcohol again in the order mentioned, till no more color could be extracted, then spread them out on slides dipped in alcohol, poured xylol over them and after letting the xylol flow off, imbedded them in Canada balsam.

In about 500 post-mortem examinations during two years (1898-'99) I had three times the opportunity of discovering one or two small foci in the right apex, while no tuberculous changes whatever were present either in the lungs or anywhere else in the body. I need only report in greater detail the first two cases; the third showed no more than I had observed in these.

The first case concerned a man 31 years old, who for several years had suffered from severe gastralgia, had submitted to a gastro-enterostomy in Hamburg, without any improvement, and a year later died here in collapse. In this man, I found in the right apex two areas of consolidation

¹ AUFRICHT: Die Lungenentzündungen. Nothnagel's specielle Pathologie und Therapie, Band XIV., Th. 2, 1899.

somewhat more than bean-sized and underneath these, separated by normal lung-tissue, a small number of grayish-white and light gray nodules of the size of millet-seeds, or smaller. In examining the larger foci microscopically, the alveoli were seen to be completely filled, some with swollen alveolar epithelium, some with red blood corpuscles exclusively, still others with an almost entirely amorphous, uniformly reddish mass which to all appearances consisted of dissolved red blood cells. This amorphous mass was mostly permeated with small nuclei, but here and there it contained light vacuoles of variable size. After long continued examination of these specimens, I became convinced that a catarrhal pneumonia, or a disease starting from the bronchi or the smaller air-passages (which is regarded as the fundamental process in the production of pulmonary tuberculosis), was here entirely out of the question. The changes in catarrhal pneumonia of children, which I had thoroughly studied, were totally different from this. Instead of this, another comparison involuntarily forced itself upon me. Changes such as those just described, I had observed only in infarcts of the lung which occurred in consequence of localized thrombosis of pulmonary vessels.¹ This gave me the incentive for researches into analogies and differences between the foci under consideration and infarcts occurring at other places in the lungs. I very soon found the vessels present in the neighborhood of these apical foci to show changes similar to those caused by hæmorrhagic infarctions due to localized thrombosis; that is, their walls were extraordinarily thickened, the adventitia in particular was broadened by fibrinoid degeneration of its fibres.

This unexpected and in the highest degree surprising discovery which suggested the tracing of the beginning of pulmonary phthisis back to an infarct, was of course not sufficient to establish a completely new view of the origin of pulmonary tuberculosis. Even the second case, which I found sometime after in a man thirty-four years old, brought into the hospital moribund from hæmorrhagic pleurisy, would not yet have induced me to appear before the forum of science with my discovery, since it is not easy to cause conviction of the correctness of such results by simple description. But in this second case, in which there were likewise two bean-sized foci present in the apex of an otherwise healthy lung, I was fortunate enough to cut a section through one of these foci in such a manner that the same appeared together with the afferent vessel and the thrombus contained therein, thereby removing all doubt concerning their relation.

¹ Cf. Die Lungenentzündungen, p. 390.

In *Fig. 1, Plate I*, the object is represented under magnification of about ten diameters. The thrombus is firmly adherent to the vessel-wall. The latter, however, is extraordinarily thickened. As a somewhat higher magnification shows, this increase in thickness depends upon an infiltration of all the coats of the vessel-wall, with numerous cells. Beside this, there are visible in the left half of *Fig. 1, Plate I*, two transverse sections of smaller vessels which are completely thrombosed. They belong to the second of the foci present.

While my researches into the origin of localized thromboses, communicated in the place mentioned, justify me in concluding that in this case, as in the first, the changes in the vessel wall must have preceded the process of thrombus formation, I also found in the neighborhood of the focus just described and sketched, other vessels whose walls likewise showed considerable thickening, although their lumina were not occluded by thrombi. The fibrinoid degeneration of the adventitia was, however, less marked than it was in the first case. In this second case the process was probably a more recent one.

As the cheesy bean-sized focus just described corresponds to the peripheral distribution of the thrombosed vessel, which can be plainly seen from *Fig. 1, Plate I*, the origin of the focus must be looked for in the necrosis of the portion from which the blood, i. e., the nutrition, has been cut off by thrombosis of the vessel.

After I had arrived at this result, I betook myself to the investigation of cheesy tubercles of the lungs, which occur often enough in the lower portions when there are extensive destructive processes in the upper lobes, or which, when the disease takes a rapid course, represent the essential tuberculous change of the whole lung and present themselves as single nodules, almost always of the same size, and of a characteristic cheesy appearance. It is particularly worthy of note that in many places they arrange themselves in little groups which from their appearance take a form which can best be denominated an acinous one.

With regard to these formations also, I first expected to find a relation between them and the ultimate bronchioles, and to prove their ends, together with the pulmonary alveoli belonging to them, to be the seat of the cheesy tubercles. I premised that the changes were analogous to those of the catarrhal pneumonia of children or of aspiration-pneumonia, especially as in the latter little foci can originate which microscopically show a striking resemblance to the acinous foci in pulmonary tuberculosis. But on closer microscopic examination the cheesy tubercles show a totally different relation. They consist almost without exception of a nucleus and a pretty

uniformly broad ring. Occasionally the former presents itself in more elongated form, to which the periphery adapts itself. The nucleus frequently consists of an amorphous, structureless mass. But not seldom the central part, stained a reddish color by the Biondi-Heidenhain stain, shows a peculiar radiate arrangement, as represented in *Fig. 2, Plate I*.

The periphery consists either of cells alone, or at least of numerous cells imbedded in connective tissue basement-substance, between which many red blood cells are present. In the neighborhood of these cheesy tubercles, however, we find smaller vessels with greatly thickened walls, as may likewise be seen from *Fig. 2, Plate I*.

This discovery made me suspect at once that the cheesy tubercle, just like the isolated cheesy focus in the apex heretofore described, is the result of the disease of the walls of the afferent vessel. However, for the confirmation of this suspicion, further proofs were needed.

That the amorphous central mass of the cheesy tubercle is the remains of broken-down, necrotic tissue, is evident. There can also be no doubt that the cheesy tubercles present in the same lung, the centre of which shows the radiate arrangement, represent an earlier stage of the process. But how was the peculiar radiate appearance to be explained? From the coloring with the Biondi-Heidenhain stain I could conclude that broken-down red blood-cells took part in the process and the finding of isolated cheesy tubercles whose centres actually consisted of well-preserved red corpuscles pointed to this. The occurrence of hæmorrhage could be easily explained if the afferent vessel was primarily involved in the process. But the radiate appearance of the central portion I first understood by the objective findings in a case of acute tuberculosis. Here I found cheesy tubercles which certainly were in the very first stage of their formation.

In *Fig. 3, Plate II*, such a tubercle is represented. The afferent vessel, with its greatly thickened wall, is cut longitudinally and tightly packed with dissolved red blood cells. All the afferent capillaries are so dilated by the damming-back of blood that they touch one another almost everywhere. Only in a few places, in the middle and at the edge of the cheesy tubercle, are they definable from one another.

Now, it is clear that in consequence of the disease of the vessel-wall there must occur in the capillaries beyond, a still further dissolution and liquefaction of blood corpuscles which are afterwards absorbed; and that the radiate appearance of the tubercle is due to the collapsing of the capillaries. But here also, as around every dying or dead focus, a peripheral inflammation takes place as a secondary stage, which manifests

itself in the ring consisting of connective tissue basement-substance, which is infiltrated with granulation cells and red blood corpuscles.

I have already said that in the last, which I may call the third stage, of the cheesy tubercle, the centre consists of an amorphous mass. The periphery is transformed into a more or less dense fibrous tissue.

The fibrous tubercle may be regarded as an after-stage of tubercle, representing a process of healing. It originates in the fibrous ring after the cheesy substance is absorbed. Probably such a healing process occurs in the lung also, without hitherto having been demonstrated; upon the peritoneum at least, such healed tubercles are found comparatively often. The majority of them have a ring of pigment which owes its origin to red blood corpuscles which became infiltrated into the periphery of the caseous tubercle in its second stage. (See *Fig. 2, Plate I.*)

For the rest, it is evident that such a thrombosed vessel, represented in *Fig. 3, Plate II*, as the first stage of the cheesy tubercle, with its congested capillaries takes up the space of several alveoli in the lungs.

The changes which occur in them, I could observe more closely only in cases in which, as already mentioned, the centre of the cheesy tubercle consisted of a mass of red blood cells. The latter had evidently made their exit from the capillaries, allowing them to shrink and thus prevent their covering the constituent tissue elements of the lungs. The alveoli were then seen to be filled with swollen alveolar epithelium. Here and there I also found a giant cell, for which the blood that has entered the alveoli apparently furnished the groundwork in which the cell-nuclei arrange themselves peripherally.

This positive proof of the origin of the cheesy tubercle in the lung by thickening of the wall of the smaller vessels, with consequent thrombosis and infarct-formation, followed by cheesy degeneration of this portion and inflammatory tissue formation at its periphery, carries with it two important conclusions :

The first one concerns the place in the lung tissue first invaded by the tuberculous process. As the cheesy tubercle depends on changes in the blood-vessels, as is here demonstrated, any primary involvement of the finer air passages and alveoli may be excluded, and all the more so because hitherto not the slightest evidence has been adduced to the contrary.

Additional proofs that primary involvement of the finer air passages does not occur can, however, be brought forward. They are furnished by the fact that the cheesy tubercles in the spleen and kidney show exactly the same histological structure as those in the lung. In the spleen and kidney also, the walls of the vessels leading to the cheesy tubercle are

considerably thickened; here also we find a reddish amorphous centre with a ring consisting mainly of granulation cells. Eminently characteristic pictures are obtained from tubercles of the kidney-cortex, if sections are cut so as to be directed toward the hilum. Then one still finds in the centre of the cheesy tubercle, vessels with thickened walls and containing well-preserved blood corpuscles.

A further proof of the origin of the cheesy tubercles independently of the air passages is furnished by the experimental production of tubercles by way of the blood-vessels. If tubercle bacilli are injected into the vein of the ear of the rabbit, the cheesy tubercles occurring in the lung conform so perfectly to those of the human lung that a further description is unnecessary. The only difference consists therein, that in the tubercles of rabbits a conspicuously large number of eosinophile cells is present.

The second conclusion concerns the relations of the *cheesy tubercle* which has thus far been considered to the exclusion of the so-called *gray tubercle*. The histogenesis of the former, as here described, excluded every direct connection with the latter, or, more precisely, the gray miliary tubercle never passes over into the cheesy tubercle. This statement can be proved not only by the independent origin of the cheesy tubercle. I shall later give positive evidence of the entirely different origin of the gray tubercle. But this I can do only after discussion of the relations of the exciting agent of the disease, the tubercle bacillus, to the pathologic-anatomic changes so far described.

The surest solution was to be expected from experimental methods. Nodules taken from lungs of cows affected with pearl disease were rubbed up with water, the mass filtered through linen, and of the fluid about $\frac{1}{4}$ to $\frac{1}{2}$ c.c. was injected into a vein of the ear of rabbits. In all the animals that died from two to three months after injection, there existed a disseminated general tuberculosis. The lungs were infiltrated with cheesy tubercles. Their structure, as already mentioned, completely coincided with that of human cheesy tubercles.

Especially surprising, however, was the existence of the same histologic change of the smaller blood-vessels in this experimentally produced tuberculosis, as I had found in human pulmonary tuberculosis. In the neighborhood of the cheesy tubercle the vessel-walls in the rabbits also were greatly thickened, even practically transformed into a mass of granulation cells.

Considering that the tubercle bacilli entered through the lumen of a blood-vessel, there could be no doubt that here the change in the vessel-walls must have occurred before the formation of the cheesy tubercle in

the area supplied by these vessels. It is as rare in experimental tuberculosis of rabbits as it is in human tuberculosis, that specimens are obtained in which the vessel whose wall is thickened by granulation cells is seen to enter directly into the cheesy tubercle. Much more frequently one gets sections of such vessels in their neighborhood. But in the chance discovery of a vessel lying in the same plane with the cheesy nodule, even an isolated finding, such as is represented in *Fig. 2, Plate I.* can suffice, especially as tuberculous kidneys of rabbits, as well as those of man, offer a better opportunity to confirm the direct connection of the diseased vessel with the cheesy tubercle. In sections which are cut from the visible tubercle in the kidney-cortex, parallel to the course of the straight tubules, one often sees smaller vessels, whose walls for some distance are greatly thickened by cell multiplication, to pass directly into the cheesy focus, as represented in *Fig. 4, Plate II.*

The conjecture now lay close at hand, that in such rabbit-lungs in which even the smaller branches of the pulmonary artery had been reached by tubercle bacilli from a vein of the ear, the vessel walls thickened by cell multiplication must also contain tubercle bacilli. The staining of the first specimen by the Ziehl-Neelsen method convinced me of the correctness of my assumption. Numerous tubercle bacilli were found between the cells of the vessel-walls.

This discovery, which I reported in 1900,¹ has been confirmed by WECHSBERG². But he assumes that the primary effect of the tubercle bacillus asserts itself as an impairment, leading to a destruction, not only of the stationary fixed cell (endothelium, alveolar epithelium), but also of the intermediary connective tissue substances present. Only through the injury to the fixed cells and to the intermediary connective tissue substances "by removal of the impediments to growth" (Weigert), does he consider it possible for a proliferation of the fixed elements present to occur.

I cannot share this view; on the contrary, I believe that the tubercle bacillus directly produces an increase in the cellular elements of the vessel-wall, without destroying the intermediate connective tissue substance, which latter I found in completely caseated tubercles of the kidney, as remaining elements of the vessel-wall.

Concerning the genetic relationship between the tubercle bacillus and

¹ AUFRECHT: Ursache und örtlicher Beginn der Lungenschwindsucht. *Berliner klin. Wochenschrift*, 1900, No. 27. Die Ursache und der örtliche Beginn der Lungenschwindsucht. Wien, Holder, 1900.

² WECHSBERG: Beitrag zur Lehre der primären Einwirkung des Tuberkel Bacillus. *Ziegler's Beiträge zur pathol. Anatomie*, 1901, Bd. 19, S. 203.

human pulmonary tuberculosis, it still remained for me to determine, after the results obtained from the tuberculous rabbit-lung, whether tubercle bacilli are present in the vessel-wall in those cases in which histologic examination showed a disease of the vessel-wall with consequent necrosis of the peripheral portion. Examination demonstrated the presence of tubercle bacilli here also. As most favorable for their demonstration proved to be such tuberculous lung-tissue in which the process had pursued a comparatively rapid course.

It is known that tubercle bacilli are present also in the foci lying peripherally to the diseased vessels, therefore in the cheesy tubercles, both in experimental and in human tuberculosis; in fact, they are generally present in greater abundance here than in the vessel-walls from which they first extend to the foci deprived of their nourishment. It was long ago shown that tubercle bacilli flourish best in broken down tissue, for instance, that they occur in greatest number on and in the walls of cavities.

After determination of the primary rôle which the bacillus plays in the origin of the disease, the positive part of the proof for the entire independence of the genesis of the cheesy tubercle from that of the gray tubercle, can now be adduced.

That there is no transition from the gray tubercle into the cheesy tubercle can be proved mainly by the fact that in general tuberculosis, mostly cheesy tubercles are found in the lungs, in the spleen and kidneys, while in the liver, on the other hand, only gray tubercles are found. It has long been known that cheesy tubercles almost never occur in this organ. It would hardly suffice to regard differences in time as responsible for this, for in an acute general tuberculosis it may be assumed with certainty that the bacilli reach all these organs through the blood-vessels at the same time, the liver being reached after the spleen and kidneys. There is only one explanation for the fact that in the last mentioned organs cheesy tubercles occur, while in the liver gray tubercles are formed despite the simultaneous invasion by the bacilli, and that is the difference in the terminal ramification of the vessels. From the excellent researches of Cohnheim we know that the spleen, kidneys and lungs are preëminently the organs in which only terminal arteries occur. If, now, as is the case in tuberculosis, the bacillus injures the terminal branches of these vessels, then the corresponding area in these organs is helplessly doomed to destruction; necrosis takes place and tubercle bacilli extend from their starting point, i. e., from the vessel-wall, to the necrotic focus in which they grow in the greatest abundance. The cheesy tubercle is thus the product of the combined effect of the necrosis and of the tubercle bacillus.

In the liver, on the other hand, there are no terminal arteries. The branches of the hepatic artery communicate with one another and their capillaries form a wide-meshed net. If tubercle bacilli remain clinging to the vessel-wall and lead to its thickening, with consequent circulatory disturbances, no necrosis of the area supplied by such vessels results, because they are still supplied with blood from other sources. The rare exceptions in which small cheesy tubercles occur in the liver can be easily explained by the fact that, in consequence of the invasion of tubercle bacilli in enormous numbers, the vessels communicating from other directions are also occluded and the corresponding parenchymatous area becomes thus totally deprived of its nutrition. On close examination, especially when the affected portions of the liver have been sufficiently hardened in potassium bichromate, whereby the red blood corpuscles in the vessels are well preserved, the latter are found in the centre of the so-called gray tubercle, always crowded together in rounded or elongated form. Even without the aid of the significant circumstance that in an acute miliary tuberculosis the tubercle bacilli reach the liver through the blood-vessels exclusively, this histologic finding entitles one to conclude that it is a question here only of blood that lies in the lumina of vessels whose walls have been extraordinarily thickened by cell-multiplication. Moreover, the miliary tubercles of the rabbit's liver, produced by injection of tubercle bacilli through an ear-vein, show the same histologic composition.

In other cases the centre of the liver-tubercle in man is formed by a giant cell which contains bacilli. This giant cell is, however, without exception, surrounded by a broad ring, consisting of cells, in which likewise many bacilli are found between the cells. On the basis of numerous transition pictures, I would assume that the basement substance of the giant cell consists of broken-down red blood cells, that their peripherally arranged nuclei originated in the vascular endothelium, and that the surrounding cell-layer corresponds to the thickened walls of the vessels.

If we next consider that, in the liver, a cheesy tubercle never originates from a gray tubercle, and if we consider the totally different origin of the cheesy tubercle in the lungs, spleen and kidneys, as described, then we may safely exclude a transition from the gray to the cheesy tubercle in these organs. If in these gray tubercles also occur, beside the cheesy tubercle, which is frequent enough, there is still not the slightest ground for the assumption that the former are transformed into the latter. The gray tubercle in the lung, as well as in the liver, is a section of a blood-vessel, and is proved to be such by its centre consisting of red blood-cells

and by its periphery being formed by numerous cells which correspond to the thickened wall of the vessel. The accompanying illustrations (*Fig. 4 and 5, Plate II*) of two gray tubercles of the lung, show this condition very characteristically. Of course it depends on chance whether, in preparing the microscopic sections, one of the minutest vessels has been cut exactly perpendicularly to the longitudinal direction. In such case and by proper preparation, the centre, consisting of blood corpuscles, will be visible. If, however, the vessel is cut longitudinally, then nothing is seen but a heap of granulation cells whose relation to the vessel-wall is not apparent. Only in one tissue of the human body can the connection of the gray tubercle with the vessels, even when brought under the microscope in longitudinal section, be certainly determined, namely, in the pia of the brain. If, in tuberculosis of the pia mater, this membrane is carefully removed from the brain, then one may succeed in removing with it numerous clusters of minute vessels which dip down into the brain substance between the cerebral convolutions. If these vessels are stained by the Ziehl-Neelsen method and examined, it can be shown that the gray tubercles containing bacilli are only greatly thickened portions of the vessel-wall, consisting of granulation cells, taking up the whole circumference of the vessel and not appearing merely heaped up on one side, in which many tubercle bacilli are found. In the lumen of the vessel also, between the corpuscles, bacilli are occasionally found.

According to this the gray tubercle is only the result of the proliferation of the elements of the vessel-wall, brought about by tubercle bacilli, and the cheesy tubercle a necrotic focus which corresponds to the periphery of a terminal artery whose wall has proliferated, through the action of the tubercle bacillus.

However, the pathogenic-anatomic process in the lung is not exhausted by the determination of the presence of gray and cheesy tubercles in consumptive lungs. LAENNEC¹ appreciated this already in his time. As to the cause of phthisis, he says on page 532: "The advances of science have clearly shown that pulmonary phthisis rests upon the development of a particular kind of accidental new tissue formation, to which modern anatomists have specifically given the name of tubercle," but, on page 542, he limits his own teaching by the following words: "Occasionally, however, tuberculous masses originate in consequence of a similar impregnation or infiltration with tuberculous matter occurring in the primary or half translucent stage, without the preceding development of

¹ LAENNEC: *Traité de l'auscultation méd.*, Paris, 1826, Tome I.

miliary tubercles." This infiltration, denominated by Laennec tuberculous, was called "cheesy infiltration" by VIRCHOW,¹ and he pointed out that not only tubercles but inflammatory exudate also can caseate. Upon this basis, NIEMEYER² adopted the view that it need not be a special type of pneumonia in order to terminate in cheesy degeneration of the deposited exudate, and that in a great number of catarrhal pneumonias, as they occur in childhood, either primary or secondary to measles or whooping-cough, the unfavorable conditions which cause caseation of the exudate may develop during the progress of the disease. BUHL,³ represented a diametrically opposite view. He was of the opinion that pulmonary phthisis starts in an inflammation of a peculiar type, which he called "desquamative pneumonia."

After the discovery of the tubercle bacillus, it seemed the simplest thing in the world to consider all processes going on in the lung as uniform and of equal value, because the exciting agent of the disease was present in all changes. Whether the disease occurred in the form of lobar or tuberculous pneumonia was regarded as a consequence of the inhalation of more or less numerous bacilli, or as the effect of poisons derived from their dead bodies.⁴ In fact, in the microscopic examination of lungs which show diffuse tuberculosis, we get the impression that a pneumonic exudation has been caused by the invasion of the bacilli, in other words, that the alveolar spaces are the primary seat of the disease. On the smoothly cut surface the tissues have partly a gelatinous, partly a reddish salmon-colored, partly a yellowish cheesy appearance. The area over which the different colorations extend varies with the duration of the process. The yellowish cheesy character, according to general agreement, corresponds to the most advanced stage of the disease, with which a more or less extensive breaking-down of tissue may be associated. Cavities with ragged walls, within the cheesy pneumonic portions are also formed. Often enough older foci or smaller cavities are present in one or the other apex which, according to their structure, must have existed long before the acute onset of the lobar tuberculous pneumonia. Not infrequently the latter follows upon a more or less profuse hemoptysis which has originated in an apical process, sometimes clinically recognised beforehand.

1 VIRCHOW: Würzburger Verhandlungen, 1850, Bd. I, p. 84; 1851, Bd. II, p. 73; 1853, Bd. III, p. 99.

2 NIEMEYER: Klinische Vorträge über die Lungenschwindsucht, mitgeteilt (Ott) Berlin, 1867.

3 BUHL: Lungenentzündung, Tuberkulose und Schwindsucht. II Auflage, München, 1873.

4 Cf. CORNET: Die Tuberculose. Nothnagel's spec. Pathologie und Therapie, Bd. XIV, Theil 2, p. 305.

The right lung in *Fig. 6, Plate III*, after a photograph which offers the most exquisite picture of a desquamative, caseous pneumonia, comes from a man twenty-four years old, who for eight months had cough and expectoration and was brought to the hospital twenty days after a very severe hemoptysis. Here the gradual development of complete dulness from above downward could be observed in the course of the eight weeks prior to his death.

If, however, such a lung is examined microscopically (and I have minutely examined, not only the one here described and illustrated, but also several other cases of desquamative pneumonia), then it can easily be shown that the changes in this process are by no means uniform, or corresponding to pneumonic consolidation, according to prevailing views. The macroscopic, seemingly uniform appearance of the lung-tissue is shown by the microscope to be of two totally different tissue alterations. There are found first, exceedingly numerous rounded foci which in their structure accord perfectly with the isolated cheesy tubercles which occur in other cases of pulmonary tuberculosis of more chronic course, as illustrated in *Fig. 2, Plate I*. Only in the centre the radiate appearance shown in this figure has frequently disappeared and there is shown the transformation into an amorphous mass, described as belonging to a more advanced stage. The thickening of the vessel-walls in the neighborhood of these foci is also present in the desquamative pneumonia. Secondly, between these foci the whole tissue is likewise consolidated, but only in that the alveoli, whose walls can remain intact for a long time, are filled with cellular material. This consists of swollen alveolar epithelium, numerous round cells and red blood corpuscles. These three kinds of cells are mostly mingled with one another, the round cells preponderating. Frequently, however, alveoli are found that contain only alveolar epithelium, and others again that contain only blood. On the preponderance of one or the other of these cellular constituents of the alveoli depends the macroscopic appearance of the lung, on section. If the alveoli are mainly filled with swollen epithelium, then the appearance is a gelatinous one; if besides the epithelium, they also contain abundant red blood cells, or contain them exclusively, then the appearance is of a more reddish salmon-color, and the consistency of the tissue is firmer. Finally, the yellow cheesy appearance is conditioned upon the preponderance of granulation-cells in the alveoli. This order also corresponds to the advance of the process from the first to the third stage.

The interstices of the alveoli also take part in the disease. They may be permeated with numerous blood corpuscles, which is doubtless a con-

sequence of diffuse haemorrhage, or they may be thickened by abundant cell-multiplication. When the interstitial tissue is thus involved it is only a question of time when a sort of softening of the whole tissue will occur. In such case we find more or less large tissue-deficiencies with ragged boundaries, i. e., cavities in the earliest stage of their formation, because the formation of cavities does not depend upon the caseous tubercles, but chiefly on the desquamative pneumonia.

Now, in view of the foregoing determination of the origin of the cheesy tubercle, the conclusion ought to be sufficiently justified that the diffuse tuberculous pneumonia, exactly like every widespread pulmonary tuberculosis of comparatively rapid course, sets in with the formation of cheesy foci in consequence of the bacillary vessel-disease, and that afterwards the pneumonic infiltration occurs between these foci. But further proofs also can be brought for this *modus procedendi*. If these seemingly diffusely pneumonic portions are examined for tubercle bacilli, these are found in the walls of the vessels leading to the cheesy foci, in the cheesy foci themselves; furthermore, in the cellular material, i. e., between the cells which fill up the alveoli, and also in the alveolar interstices, when these are widened by cell multiplication. But they are totally wanting in the newest pneumonic portions, i. e., there where the alveoli contain only their swollen epithelium, or only red blood cells, or both. The demonstration of these facts does not permit the assumption that the bacilli enter the alveoli in the first place by inhalation, because then tubercle bacilli would have to be present at least in the alveoli which are filled up with swollen alveolar epithelium.

An extremely instructive picture, clearing up the origin of tuberculous pneumonia, is offered by *Fig. 7, Plate IV*, here presented, in comparison with *Fig. 6, Plate III*. This plate shows the photograph of a section of a lung (from a man twenty-seven years old) densely studded with cheesy tubercles, in which the tissue lying between the tubercles is intact and air-containing. *Fig. 6, Plate III*, on the contrary, shows the picture of a section of the above-described right lung, completely involved in a desquamative pneumonia, that upon the post mortem table presented a uniformly yellow-gray appearance. In the left half of the photographic picture, representing a section severed from the right half by only a knife cut, the caseous foci appear with surprising distinctness. They correspond exactly to the cheesy tubercles that are visible in the lung represented in *Fig. 7, Plate IV*, with otherwise healthy lung-parenchyma. The sensitive plate with magnesium flash-light had therefore reproduced the combination of cheesy tubercles with the inflammation of the parenchyma more

distinctly than could be made out with the naked eye. That these foci are shown with peculiar distinctness, particularly in the left half, which exactly fits on the right half, is probably due to a more oblique position of the object against the photographic lens. The tuberculous (desquamative or cheesy) pneumonia can consequently be regarded only as the result of an inflammatory process in the neighborhood of the cheesy tubercles. The inflammation occurs only then in such large areas, when the development of caseous tubercles is equally extensive, involving entire lobes or even whole lungs. Thus the desquamative pneumonia differs only by its greater extent from pneumonic consolidations which frequently occur in the neighborhood of small tuberculous foci in the apex. Both clinical observation and anatomical investigations demonstrate the occurrence of such consolidations. But, on longer observation, it may often be shown that extensive dullness over the upper lobe disappears under appropriate treatment, which can only be regarded as proof that the process leading to the consolidation had its course in the alveoli. But at autopsies the pneumonic character of such dullness can be shown by the presence of changes like those characteristic of desquamative pneumonia; often enough besides, by extensive fibrous consolidation which can only be a consequence of the pneumonic process.

It is true that in the consolidations which occur in the neighborhood of foci in the apex there is also danger that softening may occur, and that therewith the first foundation be laid for cavity formation. In chronic tuberculosis confined to the apex, the greatest danger for an unfavorable course of the disease comes, not from the cheesy tubercles, but from the pneumonic process occurring between the tubercles and around them, which leads to softening of the foci and to excavation.

It would not be an easy matter to ascertain the conditions which lead to the occurrence of this pneumonic consolidation surrounding the tuberculous foci. Probably we are here concerned with a purely toxic injury traceable to the cheesy tubercles and their bacilli. At least the similarity of this pneumonic process to the changes produced by too large tuberculin injections, such as were made when tuberculin was first used, points to this, they having in isolated instances also led to tissue softening. The circumstance, however, that when cheesy tubercles are present in the apex it may happen that in one case no pneumonic consolidation occurs, while in another its advent and consequent subsidence may be clinically demonstrated, and in still other cases a chronic fibrous pneumonia results, finally that in very many cases softening of the pneumonic tissue with cavity formation, that is a complete phthisis, follows, indicates that different

causes, operating individually or with time as a factor, must be present. We need only say here, that as such causes may be regarded acquired bronchial catarrhs, overexertion, injuries, occupations conditioning the inhalation of different kinds of dust. These causes will receive more detailed consideration under the subject of predisposition.

Now, however, a new question presents itself for elucidation. If all pathologic-anatomic processes in pulmonary phthisis really depend on a disease of the wall of the smaller branches of the pulmonary artery, brought about by the tubercle bacillus, how does the bacillus get from the outer world into the lumina of these vessels?

Regarding acute general miliary tuberculosis, it has already been shown that the spread, or better, the diffusion of the bacilli, takes place from a single focus through the vascular system. But what anatomical changes take place in the smallest branches of the vessels, where the bacilli must remain adherent, remained hitherto completely obscure.

PONFICK¹ was the first to ascertain the presence of tuberculous foci on the inner surface of the thoracic duct, from which a general spread of the bacilli through the vascular system could easily come about. To be sure, this did not yet explain how the tubercle bacillus got from the outside to the inner surface of the thoracic duct.

Furthermore, WEIGERT² had proved the presence of tubercles on the inner walls of veins as a much more frequent cause of general tuberculosis. Already in 1878 he reported concerning such findings, and later, in fourteen new cases of acute general miliary tuberculosis, he found tuberculous foci thirteen times on the inner walls of veins; mostly pulmonary veins. From these foci the introduction of the tuberculous poisons into the vascular system must doubtless have taken place.

For this mode of origin of miliary tuberculosis as ascertained by Weigert, as for the mode proved by Ponfick, the same question arises: "How does the bacillus get to the inner wall of the vein?"

The possibility of the penetration of the tubercle bacillus through the vessel-wall into its lumen, KOCH³ first actually proved by the reporting of a single case. In a man thirty years old, who died of miliary tuberculosis, he found the bronchial glands moderately swollen. In these he found extensive foci, containing either no nuclei or only nuclear fragments, in

¹ PONFICK: Ueber die Entstehungs- und Verbreitungs-Weise der acuten Miliartuberkulose. *Berliner klin. Wochenschrift*, 1877, S. 673.

² WEIGERT: Neue Mittheilungen über die Pathogenese der acuten Miliartuberkulose. *Deutsche med. Wochenschrift*, 1883, S. 349.

³ KOCH: *Mittheilungen aus dem Kaiserlich. Gesundheitsamte*, Bd. 11, S. 26.

which dense aggregations of tubercle bacilli were present. The latter were found to be heaped together in large numbers around isolated smaller arteries and to penetrate here and there to the interior. There could be no doubt that they reached the blood-current in this way.

But concerning chronic pulmonary tuberculosis, no one suspected even the possibility that the path of entry of the tubercle bacillus could be otherwise than through the air-passages, i. e., by inhalation, till the appearance of my paper in the *Berliner klinische Wochenschrift*, No. 42-43, 1901. (See also *Verhandlungen der Deutschen pathologischen Gesellschaft*, Vol. IV, p. 69.) The assumption that chronic pulmonary tuberculosis originates by inhalation of the specific bacillus so dominated scientific thought that force was done to actual observations to corroborate this assumption. Whosoever presumed to assert that the inhalation theory of pulmonary tuberculosis was not sufficiently proven was no longer taken seriously, even if he expressed his doubts in the most temperate fashion.

If I just said that force was done to scientific observations, this relates to two points:

First of all, with astonishing boldness, the cardinal point was passed over, namely, the question of the first invasion of the previously healthy lung-apex by the tubercle bacillus. While I myself have always doubted that the eventually inhaled bacillus was able to attack healthy lung-tissue, while I was even forced by my clinical experience to the view that lung-disease could not occur from the inhalation of the bacillus, most observers held to the contrary view, namely, the origin of the disease by inhalation, as a settled fact, although they could offer no proof for their contention. The failure of such proof is strikingly indicated by the circumstance that not even concerning the mode of inhalation is there agreement. Some are of the opinion that the bacilli are mingled with the dust which is inhaled into the alveoli; others contend that the bacilli-containing material coughed up from the lungs is inhaled in droplet form.

Furthermore, the fact was incomprehensible that chronic pulmonary tuberculosis starts in the apices, while bacilli, occasionally at least, must get into other portions of the lung by inhalation. That the apices were favored just because they inspire well but do expire poorly, was an idea which contradicted all physical laws.

The determination of the first histologic changes in the apex, which the tubercle bacillus was supposed to bring about, was also in a bad way. No one knew anything about it, for the simple reason that a direct effect upon the epithelium of the smallest bronchioles and alveoli does not occur.

But it was practically impossible to compromise with the fact that tuberculosis and tubercle bacilli are often found in the bronchial glands without there being any tuberculous changes in the lungs, and that not infrequently in finding tuberculosis simultaneously in the bronchial glands and in the lungs, the former show a much more advanced stage of the disease than the latter. This relation has been sufficiently demonstrated by the researches of NORTHROP,¹ SCHLENKER,² WILLE,³ NAEGELI,⁴ and others.

In view of the results obtained by my histological investigations, that the inner surface of the vessel-wall is the first point attacked by the tubercle bacillus in chronic pulmonary tuberculosis, I suspected, just from the frequency of primary tuberculosis of the mediastinal glands (not at all appreciated by the advocates of "inhalation tuberculosis"), which I could confirm by my own observations, that the bacilli could get into the pulmonary vessels from these glands. It now seemed worth my while to investigate whether tubercle bacilli could not enter the circulation through the intact vessel-wall in cases where glands, in consequence of their inflammatory swelling, adhere to the vessels entering the lung-parenchyma from the hilum of the lung.

On the strength of this deduction I induced my assistant, Dr. Goerdeler, to make the proper investigations. Already, the first ones carried out by him were surprisingly successful, as I could report to the Naturforscher Versammlung at Hamburg in 1901. In several cases of acute general tuberculosis, after taking out the lung and the heart *in toto*, he cut open the pulmonary artery and veins, as well as their branches, from within the heart chambers, removed those portions where mediastinal glands adhered firmly to the vessel-wall, and after appropriate hardening and imbedding in parafin, cut cross-sections through gland and vessel-wall. In this way he succeeded in bringing the proof that from the separate glands containing cheesy foci, tubercle bacilli penetrated the wall of the vessel (which was absolutely unimpaired in histological structure) to its inner surface. In one specimen he even found a bacillus in a vascular endothelial cell.

¹ NORTHROP: Primary Tuberculosis of Bronchial Lymph Nodes. *New York Med. Journal*, 1891, Feb. 21. *Deutsche med. Wochenschrift*, 1891, No. 20, p. 687.

² SCHLENKER: Beiträge zur Lehre von der menschlichen Tuberkulose. *Virchow's Archiv*, Bd. 134, S. 145 und 247.

³ WILLE: Ueber die Infectionserreger der Tuberkulose. *Festschrift zur 69 Versammlung deutscher Naturforscher und Aerzte. Centralblatt für allgemeine Pathologie*, 1899, p. 277.

⁴ NAEGELI: Ueber Häufigkeit, Localization und Ausheilung der Tuberkulose, nach 500 Sectionen des Züricherischen path. Instituts. *Virchow's Archiv*, 1900, Bd. 160, S. 468.

After the path of the tubercle bacillus from the mediastinal glands to the lungs through the intact vessel-wall had been found, it was no longer difficult to also find the first portal of entry of the bacillus into the human body. Previously determined facts regarding the primary occurrence of tubercles and of tubercle bacilli in the tonsils, while the lungs were intact, involuntarily pointed it out to me.

KRÜCKMANN¹ has described two cases of undoubted primary tonsillar tuberculosis, in which no lung disease was present. The coëxistent disease of the cervical glands must therefore have been secondary to that in the tonsils.

RUGE² also contends for the primary occurrence of tonsillar tuberculosis. In one case, where a right tonsil of hen's egg size accompanied disease of the cervical vertebrae, the tonsil was extirpated and a great number of tubercle bacilli found therein. On clinical examination the lungs appeared sound. Besides this, in eighteen specimens obtained by tonsilotomy, he found tuberculosis or tubercle bacilli six times on microscopical examination.

Still more convincing evidence in favor of the primary occurrence of the tubercle bacillus in the tonsil are the results of GOERDELÉR'S investigations, concerning which he reported at the Naturforscher Versammlung, at Carlsbad³. During one year he examined all the autopsy material of my internal division, excepting the bodies of old persons and of those that died of extensive pulmonary phthisis, sixty cases in all, for tubercles and tubercle bacilli, and arranged his results in four groups.

In the first group he includes 21 cases of children under one year; in two of these, a girl of two months and a boy of three months, he found tubercles and tubercle bacilli in the palatine tonsils, but no other trace of tuberculosis in the whole body. Here, therefore, the tubercle bacilli must primarily have invaded the tonsils.

Specimens from living patients offered a vital support for this primary path of the tubercle bacillus. In ten palatine tonsils and sixteen faucial tonsils, that Dr. Martin Müller extirpated and had supplied for examination, tubercles and tubercle bacilli were found two and three times respectively.

In the second group of nine cases, in which the lungs and the medi-

¹ KRÜCKMANN: Ueber die Beziehungen der Tuberkulose der Halslymphdrüsen zu den Tonsillen. Virchow's *Archiv*, 1894. Bd. 138, p. 534.

² RUGE: Die Tuberkulose der Tonsille von klinischen Standpunkte. Virchow's *Archiv*, 1896, Bd. 144, p. 431.

³ Cf. Verhandlungen der pathologischen Gesellschaft, V. Tagung.

astinal glands were free, tubercles and bacilli were found in an eleven-months-old boy who died of enteritis, in the enlarged faucial tonsils and in the glands at the angle of the jaw. In a girl one year old, who likewise died of enteritis, only one tuberculous gland at the angle of the jaw was found.

In a case operated on by Dr. Hobs, the enormous package of cervical glands showed extensive caseations, and the large tonsils contained many cheesy tubercles, while nothing was clinically demonstrable in the lungs.

In the seventeen cases of the third group, having perfectly intact lungs, he found in one three-year-old boy (who had died of morbilli) a palatine tonsil containing tubercles, and tubercles in the cervical and bronchial glands; in a girl six months old, who died of whooping-cough, a faucial tonsil containing hyper-plastic tubercles, three similarly constituted cherry-sized lymph glands at the angle of the right jaw, tubercles in the cervical chain of glands, as likewise in the mediastinal glands; and in a 17-year-old girl who had died of dysentery, tubercle bacilli were found in the tonsils, the cervical and mediastinal glands.

In the fourth group of 13 cases, pulmonary tuberculosis was also present. In a five-months-old girl tubercles were found in the tonsils, the cervical glands, and the glands at the hilum of the lung, a tuberculous focus the size of a cherry in the right lower lobe, and miliary tubercles in the lungs, liver spleen and kidneys.

In a girl aged five months who died of measles, tubercles were found in the palatine tonsils, in the glands at the angle of the jaw and in the entire chain of cervical glands.

Finally, the normally-appearing tonsils of an eight-year-old girl contained tubercle bacilli, and tubercles were present in the cervical and mediastinal glands. Besides, there was general, miliary tuberculosis.

Must not such results forcibly lead one to the view that in pulmonary tuberculosis the tonsils are the first portals of entry for the tubercle bacilli, that they very frequently invade the tonsils in earliest childhood, that from the tonsils they are conveyed to the glands, and from these through the vessels to the lung tissue?

After this determination of the route which the tubercle bacillus follows from the outside world to the lung-parenchyma, the collective pathologic-anatomic changes that the lungs undergo in the course of tuberculous disease, may be arranged in three distinct courses. This division has the essential advantage over all previously given, in that it is subject to clinical judgment, through which the symptoms are placed

upon a sure basis, and a more exact diagnosis and prognosis is made possible

In the first course, which corresponds to chronic tuberculosis proper, especially of young individuals, there is at first a formation of one or several small cheesy foci in the apex, which are traceable to the entrance of a small number of bacilli into the smaller branches of the pulmonary artery. In such a case the bacilli probably enter through a neighboring vein from a cervical lymph gland and by the way of the right heart into the lung. In view of the certainly proven passage of tubercle bacilli from the mediastinal glands through the walls of larger pulmonary vessels, there can be no doubt that they can also penetrate the walls of small veins from cervical lymph glands. Why they become retained just in the apex of the lung I expect to show when I come to the consideration of predisposition.

Only in small children have I frequently found primary foci, in the lower portion of the upper lobe, or the upper portion of the lower, close to the hilum. They were rarely larger than a hazel-nut; without exception they were situated near caseated glands of the hilum, or came in contact with them.

From these glands the bacilli have penetrated a neighboring small artery and only the area supplied by this artery has been invaded by them.

The primary solitary foci in the apex, just as those occurring at the hilum of the lung, originate either from a group of acinously arranged cheesy tubercles, or they originate *in toto* by the necrosis of a somewhat larger section of tissue, after the wall of the corresponding vessel is injured by the bacilli and its lumen is thrombosed. The former mode of origin I found exquisitely exemplified at the autopsy of a one-year old child, that had died of catarrhal pneumonia. There existed in the right apex a bean-sized tuberculous focus which was composed of acinously arranged cheesy tubercles of the size of millet seeds. The second mode has already been described above, and is represented in *Fig. 1, Plate I.*

Such a focus of uniform cheesy appearance must, however, in time, be cast off from its surroundings. This was most clearly proved to me by a case in which the separation had only partially occurred.

On July 26th, 1886, a merchant thirty years old was received into the hospital. Until the evening of the 24th he was in apparent health and active in his business. On the morning of the 25th, so his house-keeper reported, he was strikingly confused, gave no correct answers, and showed great recklessness and haste. On the next morning, he tore his

bed-clothes, undressed himself completely and ran down naked as far as the ground-floor of the house, so that the house-keeper felt constrained to have him taken to the hospital. There he complained of headache, but otherwise gave no clear answers, but only muttered to himself. Percussion showed a slight tympanitic resonance over the lungs; here and there evidence of catarrh could be noted. On the next day rigidity of the neck ensued, and the pulse was a little accelerated. With only slight evening fever—100.6 F.—death occurred five days after his admission to the hospital, seven days after the beginning of his illness, without any special change of symptoms. Autopsy showed an acute miliary tuberculosis of the meninges, the lungs, the spleen, the liver and the kidneys. In the apex of the right lung there were four foci of cheesy appearance, not much larger than a hazel nut, which had already separated themselves for more than half their circumference, from the surrounding uninfiltrated tissue.

In such a case we are dealing with one of comparative frequency as far as cheesy foci are formed in an apex, without producing any striking phenomena of disease.

Often enough, however, the separation of such foci from the surrounding tissues occurs in connection with a more or less profuse hemoptysis. In any case, however, after elimination of the necrotic mass, a cavity corresponding to the size of the focus, remains behind.

Many years ago I had opportunity of observing a very instructive case of this kind. In 1879 I was asked to perform an autopsy on a man of sixty-two who had died of a paratyphlitis. In the right apex, I found a cavity of almond-size with smooth walls, and with a slate-colored, indurated periphery. Otherwise the lungs were perfectly healthy. Subsequent inquiry of relatives as to previous lung disease, elicited the surprising information that the lungs of the deceased were seriously affected forty years before, in consequence of repeated, severe hæmorrhages, and that only after several years' sojourn in Madeira could the regain his health and return home.

The peripheral induration was the remainder of a pneumonic process, which undoubtedly had contributed more to the severity of the disease than had the cheesy focus and the resulting cavity.

But even without hemoptysis, a pneumonic consolidation may readily occur in the neighborhood of such a cheesy apical focus, a fact which justifies the belief that the inflammation is not caused by the blood which has flowed into the neighboring alveoli during the hemoptysis, and which is carried outward by the activity of the ciliated epithelium. On the

contrary, the inflammation results from the above described irritative effect of the cheesy tubercles and foci upon the surrounding tissue.

In this manner a more or less extensive desquamative-pneumonia establishes itself, which may undergo resolution and healing, and need not necessarily pass into cheesy pneumonia. Only in the latter originates the destruction of lung tissue, with the formation of large cavities, while from the early cheesy foci of the apex, only small cavities are formed after their expulsion.

In other cases the pneumonia passes into the chronic form without destruction of tissue. Then extensive consolidations remain behind, which may occupy half of an upper lobe or a still larger area.

Since in the course of so long continued disease as chronic pulmonary phthisis all these anatomical changes can occur in varying associations and successions, it is evident that the appearance of the cut surface of such a lung, upon which we may find fresh gelatinous and caseous-looking foci, chronic pulmonic consolidation, cavities of varying sizes, etc., may be a most varied one.

In connection with these changes in the upper lobes newer formation of cheesy tubercles in the lower lobes may appear, owing to the enormous development of tubercle bacilli in the broken-down foci of the lung, their entrance into neighboring vessels or into the glands at the hilum, and from there into the vessels of the hilum, is easily possible, and herewith the best opportunity is offered for the further extension of the disease to hitherto intact portions of the lungs, by way of the blood-vessels. Under these circumstances new cheesy tubercles may appear in localities in which the previous tuberculous disease has been healed, as can best be seen in *Fig. 7, Plate IV*, in which there is a cavity with smooth walls, which are thickly studded with fresh cheesy tubercles.

The second course, which may be called subacute pulmonary tuberculosis, is conditional upon the occurrence of exceedingly numerous cheesy tubercles in all portions of lung-tissue, hitherto almost entirely intact. Although an older tuberculous process may be present this is limited to small cavities in the apex. The occurrence of this form is caused by a sudden invasion of the organ with very many tubercle bacilli by means of the blood-vessels, i e., through the pulmonary artery. The occurrence of a recovery in this form does not seem excluded. It takes place by absorption of the cheesy center of the tubercle, leaving fibrous tubercles behind, into which the peripheral layer of cheesy tubercles described is transformed. At least the comparatively frequent discovery of healed peritoneal tuberculosis with remaining fibrous tubercles, having,

as a rule, a blackish appearance from altered blood pigment, justifies such a conclusion. On the other hand, a recovery may be considered as excluded when to so wide-spread a pulmonary tuberculosis there is joined a tuberculous pneumonia, the relation of which to cheesy tubercles has been described above.

The third course of pulmonary tuberculosis is only a partial phenomenon of acute general miliary tuberculosis, which is traceable to an overwhelming of the whole body by tubercle bacilli through the systemic circulation.

The possibility of a clear insight into the origin and course of pulmonary tuberculosis here given and which hitherto existing opinions were unable to supply, may, I trust, contribute materially toward the scientific recognition and acceptance of my views, in regard to the path which the tubercle bacillus follows until it reaches the parenchyma of the lung.

Fig. 1



Fig. 2

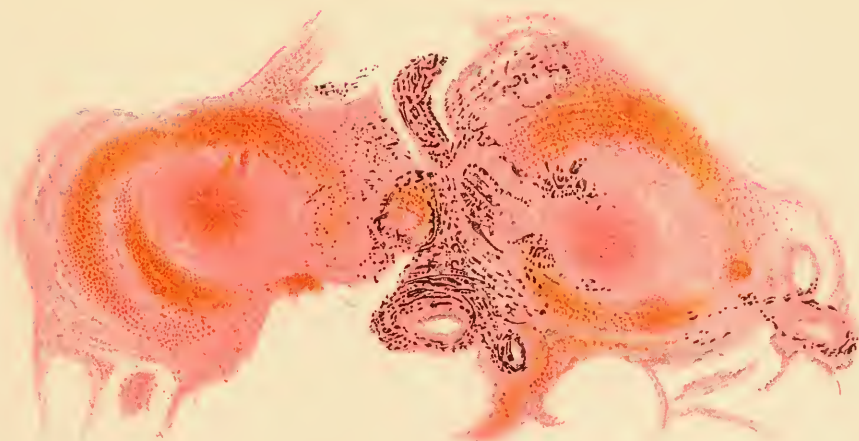
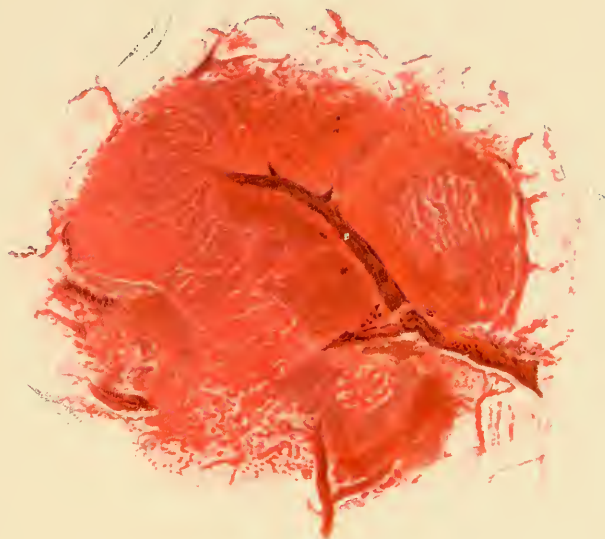
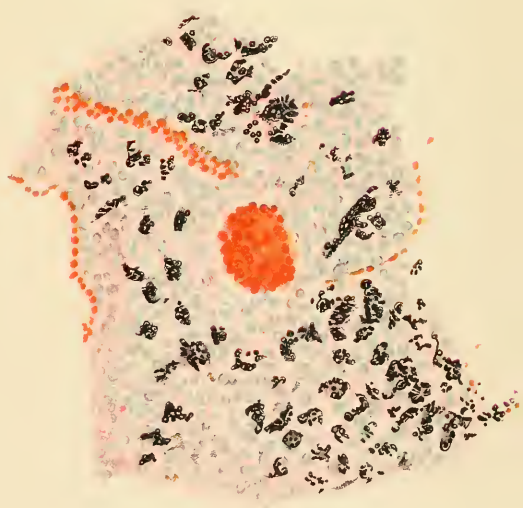


Fig. 3



REDUCED FROM ORIGINAL DRAWING ONE-FIFTH.

Fig. 5



REDUCED FROM ORIGINAL DRAWING ONE-FIFTH.

Fig. 4

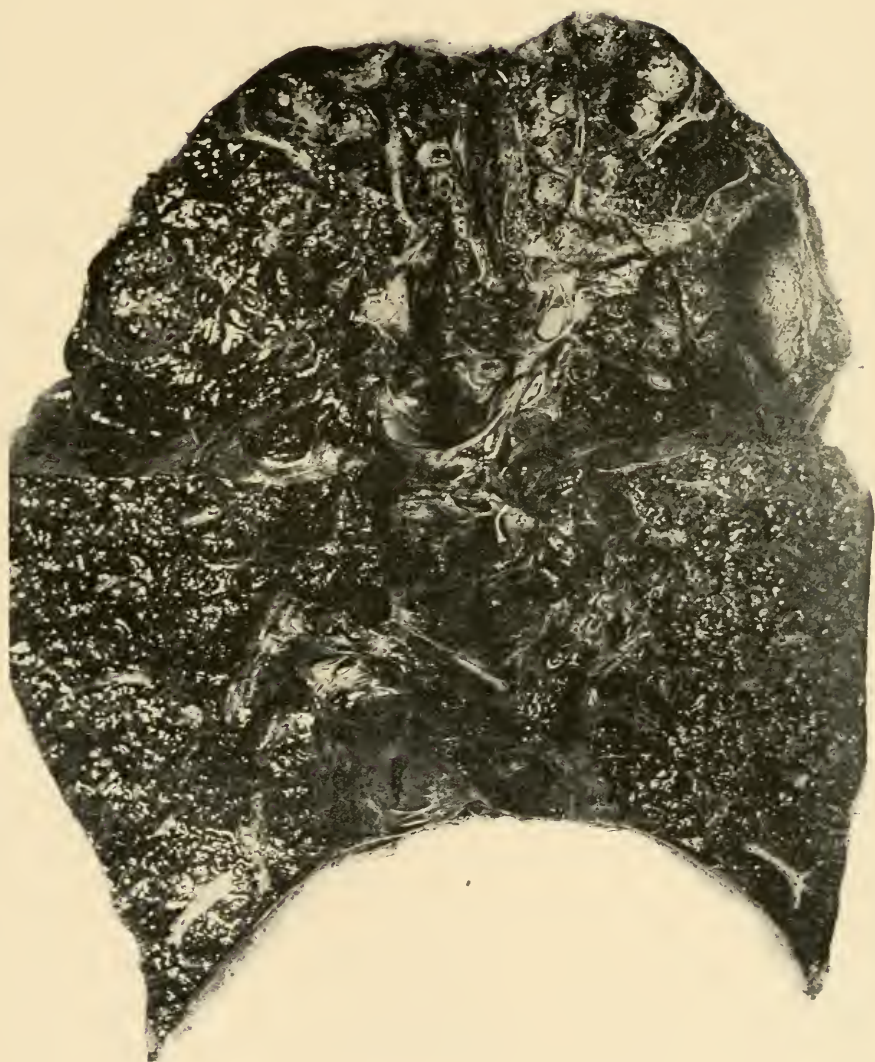


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Fig. 6



Fig. 7



DESCRIPTION OF PLATES.

PLATE I.

Fig. 1. Section through one of two tuberculous foci in the right apex of a lung otherwise sound. The afferent vessel shows a very much thickened wall and the thrombus contained in the lumen. At the left there are two transversely cut thrombosed vessels which lead to the second somewhat smaller focus. Magnified about 10 diameters.

Fig. 2. Two cheesy looking tubercles from an acinous focus in pulmonary tuberculosis. The centre shows a radiate arrangement; the periphery consists of numerous cells of connective tissue basement-substance and contains many red blood corpuscles (in this case in semicircular arrangement). In the neighborhood there are sections of smaller vessels with greatly thickened walls. Magnified about 60 diameters.

PLATE II.

Fig. 3. First stage of a cheesy tubercle of the lung. The afferent vessel, cut longitudinally, whose wall is considerably thickened, contains dissolved red blood cells, and all the capillaries belonging to this vessel are so distended with blood, that nearly everywhere they touch one another and only here and there, in the middle as well as at the edge, are they definable from one another.

Fig. 4. Two sections of vessels with thickened walls (so-called miliary tubercles). Several alveoli contain dissolved blood corpuscles.

Fig. 5. The smaller miliary tubercle (section of vessel) from *Fig. 4* Magnified 325 diameters.

PLATE III.

Fig. 6. Photograph of right lung of a man 24 years old. Complete desquamative or cheesy pneumonia. In the right half, the appearance is a uniformly yellow-gray one, while in the left half, separated only by the knife-cut, the cheesy tubercles stand out with great clearness.

PLATE IV.

Fig. 7. Section through the right lung of a man 27 years old, who died of acute tuberculosis. The organ is densely studded with uniformly large cheesy tubercles. In the lower portion of the upper lobe there is a plum-sized cavity with a perfectly smooth wall in which there are cheesy tubercles, that in appearance and also in regard to the duration of their existence, correspond to all the others.

THE MODE OF INFECTION IN TUBERCULOSIS AND MEASURES FOR ITS PREVENTION.

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THE SPECIFIC CAUSE OF TUBERCULOSIS.

It is scarcely necessary to reiterate in this day that tuberculosis is a disease caused by a specific organism, the tubercle bacillus. Much valuable information, however, can be derived from a study of its nature and manner of growth, which will be useful in our fight against the disease.

This germ multiplies only within some host or upon culture media in an incubator. It requires a temperature of from 90°-105° F. for healthy growth. When artificial cultures are exposed to chill, or to overheating, or to the light, the growth is often retarded for weeks. The germ must have darkness and moisture and when these conditions are present will often retain its virulence for months outside the living body. Various experimentators have subjected the bacillus to freezings and thawings without destroying its virulence¹. Even a temperature of 80°C. did not destroy it. It has also been exposed to acid media equivalent to that found in the gastric juice without having its virulence destroyed.

Recent investigators have shown a difference between the bacillus of the human and that of the bovine species which has somewhat clouded the subject of intercommunication for the time being. These differences are:

1. In form.
2. In growth upon culture media.
3. In virulence when inoculated in other species.

The two species are alike, however, in that:

1. Either the bacilli of bovine or of human origin will produce the disease in other animals, such as guinea pigs, rabbits and monkeys.
2. The tuberculous process is the same from whichever source the germ may come.
3. Tuberculin, from whichever culture made, produces reactions in both bovine and human tuberculosis^{2, 3, 4}.

¹ KNOFF: Prophylaxis and Treatment of Pulmonary Tuberculosis, p. 40.

² KOCH: Address before the London Tuberculosis Congress.

³ REPP: *American Medicine*, Oct. and Nov., 1902.

⁴ DESCHWEINITZ: Paper before the American Climatological Association, 1902.

CONTRIBUTING FACTORS.

Tuberculosis is not a disease which is likely to infect the strong and healthy. It is the recognized opinion that a lowered resistance is necessary to infection. WRIGHT¹ says: "The majority of individuals are immune to ordinary doses of tubercle bacilli, accidentally taken in; and yet there are individuals who are apparently infected by the smallest of such doses." The tubercle bacillus is found wherever civilized man goes; but most of the bacilli that find their way into the human organism enter either dead or in a state of lowered virulence. They are floating about in the dust of the streets, in public halls, in offices, and in private houses where conditions are unfavorable to them. Hence they are of low virulence and, when breathed in by healthy persons, are not likely to cause infection. This is the casual way in which all persons are being constantly exposed to the bacillus. If a person's vitality be low, and his resisting power far below the normal, and if he be suffering from a catarrhal condition of the mucous surfaces with which the germs must come in contact, then he might become infected. He would offer an easy ingress to the germs and a feeble resistance when entrance has been once gained. We can readily believe that children, when weakened by disease, may easily become infected, even by germs of feeble virulence. The greatest danger to human beings, however, comes from a close contact with the bacillus, when in a virulent state, as when living in apartments, or associating in offices and workshops with tuberculous subjects, who are careless of their expectoration; especially, if sanitary measures are not properly carried out. Under such conditions, when reduced in vitality as by overwork, business worries or disease, any person is liable to become infected.

That the tubercle bacillus alone is not enough to cause tuberculosis is a matter of common belief and general observation. That insanitary conditions, unhygienic living, and lowered resistance alone are not sufficient to cause it, is proven by the history of such people as the Icelanders, the American Indians, and those occupying central Africa. These people lived in huts of filth and squalor, subjected themselves to prolonged fatigue, suffered from low vitality, consequent upon disease; yet they did not suffer from tuberculosis until the other cause, the tubercle bacillus, was communicated to them. Then their ranks underwent a rapid decimation.

So, for tuberculosis, we have two causes, one subjective, one objective; both preventable. Without the bacillus there would be no tuberculosis;

¹ WRIGHT: *New York Medical Journal*, June 24, 1899, p. 874.

without lowered resistance it would be uncommon, but, with both present, we have favorable conditions for its spread. To combat it, it is not sufficient simply to turn our attention to the destruction of tuberculous discharges. We must also address ourselves most assiduously to the work of increasing the resisting power of the individual. Better sanitary conditions must surround our people, better hygienic conditions attend their mode of living and a more natural life must be pursued.

THE MODE OF DISSEMINATING TUBERCLE BACILLI.

Since tubercle bacilli do not develop outside of the body except under artificial conditions in incubators, every new case of tuberculosis can be traced to some previous one, either in a human being or some animal.

Every intelligent person who has tuberculosis, can, by care, help in preventing the spread of the disease. The bacilli are given off only through discharges from the tuberculous ulcer. If this be in the lungs, as it usually is, then the bacilli can only be disseminated through the expectoration, and, when this is destroyed, all danger is taken away. In ulcerated intestinal tuberculosis, and, perhaps, also when tuberculous sputum is swallowed, the feces are also capable of spreading the infection. Discharges from tuberculous ulcers contain bacilli in great numbers. KNOPF¹ is authority for the statement that a person in the well advanced stage of pulmonary tuberculosis will cast off in his expectoration as many as seven billion bacilli daily. These patients, as a rule, go about expectorating here and there, taking no care against the spread of infection. In this way homes, offices, workshops, halls, and public conveyances are infected. The bacilli are disseminated through ignorance or carelessness or both. Our hope of eradicating the disease lies in education and enforced care.

Sputum is of no danger as long as it remains in a moist condition; but when it dries and flies about as dust, it contaminates the air. In this dried condition bacilli retain their virulence from three to six months². Sputum cast out in open space where the sun can shine upon it is of little danger³; for the direct rays of the sun will destroy the bacilli in from a few minutes to a few hours; and even diffuse light will kill them, though requiring a somewhat longer time. But when it is expectorated in damp, dark corners, the bacilli remain virulent for a long time. In buildings the danger is greater, for they are often poorly lighted and so

¹ KNOPF: *The Prophylaxis and Treatment of Pulmonary Tuberculosis*, p. 35.

² CORNET: *Die Tuberculose*, p. 27.

³ SOLLY: *Medical Climatology*, 1897, p. 81.

constructed that the sun's rays cannot enter. Experiments have been made¹ which show that bacilli will live in such surroundings, retaining their virulence for months. In prisons and barracks and in the slums of our large cities, conditions very favorable to the perpetuation of the life of the germ are found; and the houses of the well-to-do are often so constructed that the rooms are dark and sunless, thus offering the conditions best suited to the bacillus when outside of the body.

KITASATO² has shown experimentally that a great proportion of bacilli coming from large cavities are dead. This is a comforting fact, especially when considered in connection with the destructive action of the sun's rays and diffuse light upon the germs, and explains why infection is not more frequent when the number of tuberculous patients is so great and each one casts off his millions of bacilli daily during the long months of his illness.

THE INTERCOMMUNICABILITY OF HUMAN AND BOVINE TUBERCULOSIS.

It had long been supposed and had gone without question that bovine tuberculosis was a source of infection to man, until the memorable address of Prof. KOCH³, at the recent Tuberculosis Congress, in which he detailed the results of his unsuccessful attempts to inoculate cattle with human bacilli, and drew the conclusion that "human tuberculosis differs from bovine, and can not be transmitted to cattle"; and the converse, that "one is already at liberty to say, that if such a susceptibility (to bovine bacilli) really exists, the infection of human beings is a rare occurrence."

These statements, coming from him who is acknowledged to be the greatest living bacteriologist, startled the scientists of the world. Some accepted them at once; others questioned. During the past year much has been written upon the subject and many valuable experiments have been begun which will, doubtless, throw light upon the question.

Some investigators claim positive results in the infection of cattle with human bacilli (BOLLINGER⁴, RAVENEL⁵, ARLOING⁶, and BEHRING⁷), while many authentic cases of infection of human beings from

¹ SAWITZKY: *Centralblatt f. Bacteriologie*, Bd. XI., 1892.

² CORNET: *Die Tuberculose*, p. 27.

³ KOCH: London Congress, 1901.

⁴ BOLLINGER: *Münch. med. Wochenschrift*, Jan., 1899.

⁵ RAVENEL: *Univ. Pa. Med. Bul.*, May, 1902, p. 66.

⁶ ARLOING: *Bul. de l'Académie de Med.*, Dec. 24, 1901.

⁷ BEHRING: *Beiträge zur Experimentelle Therapie*, 1902. *Journal of Tuberculosis*, Vol. IV, 1902.

cattle have been brought forth (RAVENEL¹, OLLIVIER², DEMME³, ERNST⁴, and LEONHARDT⁵).

The question can not be settled except by long and patient observation and experiment; however, from the work of the past year, we may be permitted to draw the conclusion that the bacillus of human and that of bovine origin are only different varieties of the same species⁶, and that under certain conditions, as that of passing them through other animals, it is most probable that they may be made each pathogenic for the other's host, if they are not naturally so. And, too, it is probable that, even although transmission through meat and milk are rare in adults; nevertheless, such transmission might occur frequently during infancy and childhood. For it must be remembered, that children offer a more feeble resistance to bacterial infection than adults and their mucous membranes are more easily penetrated. Whether or not infection does often take place through the ingestion of milk, we are not able to say; for, it is not necessary that even the neighboring lymph-glands be affected, although the germ has passed through the bowel. The bacilli may pass through the mucous membrane, be taken up by the lymph stream and carried, through the thoracic duct, directly to the lungs without leaving the least trace of their intestinal origin (THEOBOLD SMITH⁷).

STILL⁸ examined the post-mortem records of the Hospital for Sick Children in Great Ormond Street, and found that in 29.1 per cent. of the cases the infection seemed to be primarily of intestinal origin; and Shennan, those of the Royal Hospital for Sick Children in Edinburgh, finding 28.1 per cent. In these two series there were 547 records examined. Other observers have noted quite a large per cent. of cases in which the mesenteric and retroperitoneal glands were affected. So evidence is not altogether wanting that tuberculous infection in childhood may be of intestinal origin; on the other hand, the possibility of its being so is unquestioned.

The much quoted statistics of Thorne show that while there was a reduction in the mortality from pulmonary tuberculosis in England and

¹ RAVENEL: *Univ. Pa. Med. Bul.*, Feb., 1902, p. 453.

² OLLIVIER: OSTERTAG. *Hanbuch des Fleischbeschau.*

³ DEMME: Quoted in *Sajous' Monthly*, Sept. 1901, p. 333.

⁴ ERNST: *Rep. Mass. Soc. for Prom. Agric.*, p. 4.

⁵ LEONHARDT: WATSON in report of N. H. Board of Health, 1892.

⁶ DE SCHWEINITZ: Paper before the American Climatological Association, 1902.

⁷ THEOBOLD SMITH: *Journal of Experimental Med.*, Vol. III., p. 507-8-9.

⁸ MCFADYEAN: Paper before Tuberculosis Congress, London, 1901.

Wales, between the periods 1851-1860 and 1891-1895, amounting to 45.4 per cent., the reduction in abdominal tuberculosis amounted to only 8.5 per cent.; and, in children under one year (the milk drinking period) the mortality from abdominal tuberculosis actually increased 27.7 per cent. Thinking that some light might be thrown on the subject of intercommunicability, SALMON¹ compiled the following statistics showing the number of cases of abdominal tuberculosis per year per million of inhabitants, at all ages: New York City, 13; Chicago, 17; Boston, 32; Berlin, 40; Paris, 61; London, 221; England and Wales, 202; Scotland, 223; Ireland, 231; and says in explanation of these figures that they are in harmony with the fact that there are more tuberculous cattle in European countries than in the United States; better protection by meat inspection in the United States and the continent of Europe than in Great Britain and Ireland, and a more universal sterilization of milk on the continent.

Granting that bovine tuberculosis is transmissible to man, the degree of danger is variable. In the first place, from twenty to thirty per cent. of milk-producing cattle are tuberculous. But there is no great danger in the milk, except the udder be affected, which occurs only in about two or three per cent. of the cattle diseased². If the milk coming from diseased udders is used undiluted, the number of bacilli ingested might be very large; but, if it is mixed with milk from other cows, then the number of bacilli that one person will ingest is quite small.

Until the matter is settled, stringent measures should be carried out for the protection of man from the danger of infection from this source; and, even if it were proven that the diseases in cattle and man are different and not intercommunicable, still sanitation would demand the same stringent protective measures, for human beings should not be fed on diseased meat and milk.

THE MODES OF INFECTING NEW INDIVIDUALS.

That which stands next in importance to an understanding of the cause of tuberculosis, is a knowledge of the manner in which the infection takes place. Formerly it was generally believed that there was only one way that infection could take place and that, by breathing the bacilli directly into the lungs; but now that method seems to be unable to account satisfactorily, in very many cases, for many phenomena connected with the beginning of the disease. While we must still admit the possi-

¹ SALMON. *Journal of American Medical Association*, Dec. 20, 1902, p. 1573.

² *Ibid.*

bility of direct infection, yet we believe that it is much less frequent than is generally supposed. There are several ways in which tubercle bacilli may be taken into the system :

1. Through heredity, in which the disease is communicated directly at birth from the mother to the children^{1, 2, 3}.
2. Through the respiratory system, either by direct inhalation or by the passing of the bacillus through the mucous membranes of the upper air passages.
3. By ingestion ; the bacillus being taken into the system with food or with mucus which is swallowed.
4. By absorption through surface wounds.

In the study of the modes of infection, for all practical purposes, we may ignore heredity, for the authentic cases are so few in number that they are of interest only in showing that such a mode of infection is possible.

The frequency of direct absorption through wounds and abrasions is not great, but we occasionally hear of cases where a washerwoman, who washed the soiled linen of a tuberculous patient, or of a janitor who cleaned the cuspidors, becoming infected through open wounds of the hands ; and we all have seen the enlarged glands of little children who suffer from eczema capitis ; and, we also know that these children later often develop tuberculous glands.

Those who have been the most careful students of the subject of tuberculosis have for a long time been of the opinion that there were difficulties, almost insurmountable, in the way of direct inhalation. FLICK⁴, from certain observations, was led to believe that the stomach offered the most frequent point of entrance to the bacillus, and, fourteen years ago expressed himself as follows : " At any rate, I am under the impression that his (the bacillus') principal avenue into the economy is through the stomach ; and, only when that organ is off its guard can he secure entrance." KNOPF⁵ says : " I think it is not surprising, when looking into the exact etiology of many cases of pulmonary tuberculosis, we find that a very large number must have been caused by the ingestion, not the inhalation of the bacillus."

¹ CORNET: *Die Tuberculose*, S. 250.

² HAUSER: *Deutsch. Arch. f. klin. Med.*, Bd. I, XI., Heft 5 u. 6.

³ KNOPF: *Maryland Med. Jour.*, Aug., 1901.

⁴ FLICK: *The Contagiousness of Phthisis*, Trans. Med. Soc. Pa., 1888.

⁵ KNOPF: *Prophylaxis and Treatment of Tuberculosis*, p. 67.

It would seem that the normal anatomic conditions of the lung would make the direct inhalation of the bacillus into the air cells or the finer bronchi almost impossible. . The many turns and curves in the passages, the moisture of the surfaces, the waving action of the cilia, the residual air, together with the penetrability of the mucous membranes, all militate against it; nor does microscopic examination of these organs show particles of dust, soot or other foreign material in the ultimate air passages and air cells. On the other hand, these particles are found in the lymph-spaces and lymph-glands where they have been carried by the lymph-stream or wandering cells.

The bronchial and cervical lymph-glands are infected in a large proportion of children. In nearly all do we find these glands enlarged some time during the early years of life, and in many of them does the inflammation become chronic. Investigation shows that these chronically inflamed glands are in many instances tuberculous¹.

It is not necessary that a mucous surface immediately contributory to the infected gland be the point of infection, for the bacilli can be carried through the lymph stream from distant parts of the body. LATHAM². explains the infection of the bronchial glands even, to be due in certain cases to ingestion of the bacillus, it being carried to these nodes by the lymphatics. That they are frequently infected by direct absorption from the mucous membranes of the mouth and oral cavity, there is no doubt.³, ⁴. In this connection, GUTHRIE⁵ says: "The preponderance of thoracic over abdominal tuberculosis is not necessarily and solely due to the direct entry of bacilli into the air passages. The lungs may be infected by the bacilli entering the thoracic glands through the lymphatics of the pharynx, tonsils and oesophagus above, and through the lymphatics of the intestines and abdominal glands below, and by the entry of bacilli through the thoracic duct into the pulmonary circulation via the right heart. Primary infection through the alimentary tract does not prove that food has been the sole source of evil."

We are forced to the conclusion that the lymphatics are the chief ports of entry for the bacillus tuberculosis, whether the invasion comes from the upper air passages or the intestinal tract.

This glandular enlargement, so often found in children, is not to be

¹ OTIS: *Medical News*, July, 1898, and *Trans. Amer. Clin. Assoc.*, 1899.

² KNOPF: Quoted in *Md. Med. Jour.*, Aug., 1901.

³ HUEBNER: *La Tuberculose Infantilis*, Oct. 15, 1899.

⁴ WRIGHT: *Med. News*, Jan. 19, 1901, p. 85.

⁵ GUTHRIE: *The Lancel*, 1899, Vol. II., p. 286.

treated lightly, for it is often a cause of future outbreaks of the disease¹. Careful observation points to the fact that a great proportion of cases of pulmonary tuberculosis, which develops later in life, are but extensions of infection from these glands in which the bacilli were deposited during childhood.² OSLER³ says: "It is safe to say that in three-fourths of the instances of acute tuberculosis, the infection is derived from this source."

In tuberculous meningitis and miliary tuberculosis the infection comes from this same source. In a contribution to this subject, HAUSHALTER and FRUHINSHOLZ⁴ say: "In almost all cases, therefore, the origin of the bacillary infection which ends in the miliary form and in meningitis, is in caseous tracheal and bronchial glands."

VON RUCK⁵, in speaking of the mode of infection, says: "Tuberculosis does not as a rule occur primarily in the parenchyma of the lung, but has its beginning in the glandular and lymphatic structures of the respiratory or digestive apparatus. In many instances these initial deposits cause little or no symptoms at all. The lung affections represent an extension from a granular or lymphatic focus which has broken down, and from which the infectious material enters the venous circulation to be filtered out and deposited in the capillary system of the lungs."

In this connection I wish also to quote Delafield and Pruden⁶ who say: "The whole picture of acute tuberculosis is such, however, as to give the impression that infection usually takes place through the blood vessels and lymphatics."

It would seem from a careful study of the statistics at hand that, in at least a very large proportion of cases of tuberculosis the infectious bacilli were taken into the body through the mucous membranes of the upper respiratory and digestive tracts. When once through the mucous membrane, they find themselves in the lymph-spaces whence they are either carried and deposited in the neighboring or some remote lymph gland, or find their way through the thoracic duct into the pulmonary circulation, to be strained out by the small vessels of the lung.

MEASURES FOR THE PREVENTION OF THE SPREAD OF INFECTION.

Knowing the cause of infection in tuberculosis and knowing the

¹ JACOBSON: *Journal of Tuberculosis*, Vol. IV., p. 29.

² STEFFEN: *Zur Pathologischen Anatomie des Kindlichen Alters*, p. 159.

³ OSLER: *Text Book*, 1892, p. 206.

⁴ HAUSHALTER and FRUHINSHOLZ: Paper before London Congress, 1901. *Trans.* Vol. III., p. 388.

⁵ VON RUCK: *Journal of Tuberculosis*, Vol. I., p. 1.

⁶ DELAFIELD and PRUDEN: *Pathological Anatomy*, p. 454.

nature of the specific bacillus, we can formulate rules which, if put into practice, will prevent the dissemination of the disease. Without the bacillus, there can be no tuberculosis. If the discharges from tuberculous foci are destroyed there will be no bacilli. Therefore the question of effectually preventing tuberculosis would seem to resolve itself into that of finding means of destroying sputum and other tuberculous discharges. If it were possible to do this in every case, the disease could be conquered in a very short time, but such a desideratum is not easy of accomplishment, and we will be compelled to use all other methods that science reveals to us which will strengthen the organism against the invader.

It is a sad thing to realize that one of our fellow-citizens dies every five minutes of this disease. Owing to its lingering nature, it is necessary for the majority of those afflicted to earn their living while in the active stage of the disease, and while they are throwing out millions of bacilli daily. We find these poor unfortunates everywhere associated with other workmen; so it is necessary to take precautions that they do not infect their fellows.

Every tuberculous individual should know that he has the disease, and should be instructed how to care for the discharges so that his fellows may not become infected. Not only should he be instructed; but, if necessary, he should be compelled to do so. Health boards should be empowered to enforce such regulations as are necessary to check this disease.

Laws should be passed and enforced against expectorating in public places.

The owners of factories, stores and offices, where numbers of men are forced to work together in the same room, should be compelled to furnish cuspidors, containing some efficient germicide, in which the men should be required to deposit all expectoration.

Rooms occupied by tuberculous patients, who have reached the open stage of the disease, should be thoroughly disinfected before being again occupied. This should apply to hotels, sleeping cars, berths on steamers, offices and workshops, as well as to private houses.

Notification is necessary if we ever hope to cope with this scourge. When a case of tuberculosis is discovered, it should be immediately reported to the authorities and some one should be detailed, either the regular attending physician or some member of the health board, to instruct the individual and his attendants as to the precautions necessary in order to prevent the spread of infection. While I recognize that notification is not held in favor, yet it is necessary. Notification is not held

in favor in other communicable diseases, but it is enforced in spite of opposition, because it is necessary for public safety. In the case of tuberculosis it should not be in the form of a quarantine, but simply a coöperation on the part of laity, physicians and health boards, in order to avoid the spread of this preventable scourge. It should be understood that the health board is notified that it may instruct those afflicted and those who must care for them, not that it may punish them by branding them as dangerous. As no quarantine sign would be necessary, all the transactions relative to this disease could be and should be carried on in privacy, thus taking away the greatest objection to notification.

The laws regarding buildings can not be too stringent for the safety of occupants, for it is shown by statistics that seventy-five per cent. of all new cases of tuberculosis develop in those who have occupied apartments or who have associated intimately, as in living room, workshops and offices, with those who were ill with the disease.

ORIGIN AND GROWTH OF SANATORIA FOR TUBERCULOSIS IN MASSACHUSETTS.*

BY VINCENT Y. BOWDITCH, M. D., BOSTON.

*Medical Director of the Sharon Sanitarium, Sharon, Mass.,
Attending Physician to the State Sanatorium, Rutland, Mass.*

Mr. President and Members of the Clinical Society, and others :

While our medical journals are filled with articles upon tuberculosis, it may seem almost superfluous for me to appear before you on a special occasion to thrum upon the same string, as it were. The courteous invitation of your President to address you upon the subject of the sanatorium treatment of tuberculosis encourages me, however, to believe that the results of my personal experience of twelve years in this special direction may be of interest and possibly helpful to you in your endeavors to establish a state sanatorium in Maine. With this thought in mind, I shall give you brief histories of the birth and growth of the two institutions with which I have been connected, and of the methods employed and of the results obtained.

The fresh air treatment of consumption was advocated as far back as the time of Hippocrates ; but not until Brehmer, of Goerbersdorf in Silesia, had established his sanitarium over forty years ago and proved after a time that patients could be cured by such methods, did the idea receive marked attention. Dettweiler, Brehmer's pupil, afterwards obtained similar results at Falkenstein. Their ideas took root and bore fruit as shown by the slow and steady increase in number of small and large sanatoria in Germany during the past twenty years.

Trudeau established his now famous institution at Saranac Lake, N. Y., nearly twenty years ago and his example has been a shining light to all his followers in this country. Later von Ruck, in the mountains of North Carolina at Asheville, proved what can be done to bring tuberculous patients back to health. Of more recent date are notably the Loomis Sanitarium, at Liberty, N. Y., and the Aiken Cottage Sanatorium, at Aiken, S. C., under the management of Dr. C. F. McGahan.

You may recall the researches of my father, Henry I. Bowditch, upon the prevalence of consumption among people who live upon a damp

* An address given before the Clinical Society, the Lister and Pathological Clubs, at Portland, Maine, February 2, 1903.

soil, the results of his work being brought forth in 1862 in an address before the Massachusetts Medical Society. His experience taught him that by the comparatively simple method of making patients move from a low, damp situation to one where sunshine and a dry cellar were features of their dwelling, the health of a whole family could be favorably affected. It was his frequently expressed wish, which I often used to hear, that he had some place in the country, not very far from Boston, where he could send patients who could not afford to go far away, to live in the open air and so combat the early symptoms of pulmonary disease. Filled with this idea as a young practitioner, I determined to make the experiment, if possible, of establishing a small sanitarium for people of very limited means, within easy access of Boston, where the same general rules could be applied as in the mountains of Silesia or in the Adirondacks. An appeal to wealthy people in Boston resulted in the accumulation of a fund sufficient to build a small institution in Sharon, Mass., in a properly selected spot on a hillside, where a gravelly soil, protected by woods on the north and northwest, and an excellent water supply gave most of the essentials for a sanitarium. The scheme was, of course, decidedly of the nature of an experiment, for up to that time no such institution had been established within ten or twelve miles of the seacoast and at an altitude of only slightly above 300 feet, and in a climate combining all the attributes thought to be specially favorable to the production of consumption. It was built for patients of limited means only, the price being but \$5.00 per week, and was meant, not for the hopelessly ill, but for those susceptible of recovery or of marked improvement.

In February, 1891, the Sharon Sanitarium was formally opened for women only, the number of patients being, both from necessity and from the desire to observe carefully, limited to nine. Before many years had passed, the favorable results were apparently impressive enough to convince even the most skeptical, that a great deal more could be done by such methods, for the cure of consumption near Boston, than had been previously thought possible, except in comparatively rare instances. So successful has the work been, that in consequence of a bequest, the Sanitarium was enlarged over a year ago to a capacity of twenty-one, and the number of applications constantly increases. The Directors frequently receive letters from former patients, now in apparently perfectly good health, who from two to ten years ago were seriously threatened with disease, a proof not only that the symptoms may become arrested during treatment at the sanitarium, but that under favorable conditions the con-

tinuance of good health is in a large percentage of cases not only possible but probable.

The percentage of favorable results at Sharon has steadily, but surely increased, by which I mean, that whereas at first we had but 33% of the whole number of cases in whom the symptoms were arrested, we had in the last report 54%. This improvement has been due to different causes, probably :

1. The ability to select the cases more carefully.
2. Improved methods of care and treatment.

3. The forcing of the fresh air treatment to its utmost limit, (which is, to my mind, the chief factor in the favorable results). Methods, which a few years ago would have been thought almost insane, viz., having the windows of the sanitarium open constantly, night and day, winter and summer, have been followed by such marked improvement in the results, that it leaves no shadow of a doubt in my mind, as to the wisdom of having slowly and cautiously experimented in this direction *with suitable cases*. As to the details of the open air treatment I will speak later. Let me now trace further the development of the sanitarium treatment in Massachusetts.

In 1895, a bill was introduced in the Massachusetts Legislature for the establishment of a state institution for poor consumptives. The bill passed with comparatively little opposition and the sum of \$150,000 was appropriated for the purpose. The Board of Trustees, departing a little from the original intention of the bill, decided wisely to make the institution a sanatorium for cases susceptible of cure and not a hospital for the hopelessly sick. The results have been such as to amply justify the decision. The town of Rutland, in central Massachusetts, twelve miles from Worcester, was selected, not because of any remarkable climatic conditions as compared with other towns of moderate elevation above sea-level, but because of special advantages in the location of the Sanatorium itself—shelter from the north and northwest by a hill and woodland, an excellent water supply, the moderate elevation, (1100 feet above sea-level) insuring a reasonably pure and bracing atmosphere, the character of the soil, although not as porous as in some other districts, being such as to insure good drainage. The buildings, arranged in a fan-like shape, pointing in a southerly direction, were so made as to obtain the maximum of sunshine and air, sun-rooms and verandas being placed at the end of each ward. Accommodations under the first appropriation were made for 175 patients, male and female. It was formally opened in October, 1898. In consequence of an additional appropriation of about \$125,000, a new

administration building, entertainment hall, dining-room and new wards have been erected during the past year, thus making accommodations for 250 patients. The majority of the patients are in open wards. Comparatively few are, for certain physical reasons, placed in small, separate rooms; but the price of board (\$4.00 a week) is uniform, no special privileges being allowed to any patient except for medical reasons.

In speaking of the birth and growth of sanatorium treatment for tuberculosis in Massachusetts, the institution at East Bridgewater, founded about three years ago by Dr. Charles Millet, of Brockton, should here be mentioned, inasmuch as it forms the third of the trio, thus far the only genuine institutions of the kind in Massachusetts. Dr. Millet's sanatorium differs from those at Sharon and Rutland in that he receives a class of patients who can pay more for their privileges. With commendable wisdom and kindness, Dr. Millet receives a few of the poorer class, however; but, as the institution is dependent entirely upon the board of patients for its support, it naturally is impossible to receive many at reduced rates. Inasmuch as accommodations for the well-to-do are almost as important as those for the poor, Dr. Millet's sanatorium fills an important place in our community. A visit to this institution would well repay anyone interested in the subject. The methods employed are similar to those used elsewhere, Dr. Millet having done admirable work previously in teaching his private patients among the poorer classes the value of sleeping outside their houses in rough shelters made for the special purpose. The excellent results at East Bridgewater are another proof of how much can be accomplished at a low altitude not far from the sea.

In speaking of results at Sharon and Rutland, I shall have to give a short explanation of my use of certain terms. Up to the present, in twelve years' work at Sharon, I have never used any term, at time of discharge, other than "arrested" to express a cessation of the symptoms of disease, although in many cases the term "cured" or "apparently cured," could from the general appearance of the patient and the absence of abnormal symptoms have been, perhaps, with justice applied. Possibly this conservatism on my part is not to be commended, but the treacherous nature of the disease still makes me unwilling to use more favorable terms. The term "cured" I hardly ever employ until the patient has been away from my care for two years without the return of abnormal symptoms. I think I stand almost alone in my use of terms and I certainly regret that it seems well nigh impossible for any number of men to agree upon a definite nomenclature. With this explanation, however, I can

state, that during the last two years, at least 50% of all the cases that have entered the Sharon Sanitarium have left with the disease "arrested." It should be stated, however, that by no means all of the cases were incipient, many of them having decided disease in one or both lungs, the results in such cases having been most gratifying and often unexpected.

I append the tables of results at the Sharon Sanitarium for the years 1901 and 1902, dating from the first of March in each year, the latter year lacking only four weeks of completion:

| | 1901-2 | 1902-3 |
|---|--------|--------|
| Cases discharged as "arrested," | 54+ | 50 % |
| " " as "improved" (much or little) . . | 38+ " | 36+ " |
| " " as "not improved" | 7+ " | 13+ " |

In speaking of results at the Rutland Sanatorium, I give tables relating only to my department which comprised up to last autumn a little more than half of the whole number of patients, or an average of about 95 constantly under my supervision.

| | 1898-99 | 1899-1900 | 1900-1 | 1901-2 |
|--|---------|-----------|--------|--------|
| Cases discharged as "arrested" | 30.97 | 39.7 | 42.23 | 46.63 |
| " " as "improved" (much or little) . . | 46.10 | 52.4 | 53.79 | 41.95 |
| " " as "not improved" | 21.23 | 7.9 | 3.98 | 11.39 |

Even allowing for the inevitable fluctuations of percentages from year to year, it will be seen that the percentage of "arrested" cases at Rutland has steadily increased since the first year, this being due, doubtless, to the same reasons as given for the results at the Sharon Sanitarium.

In comparing the foregoing tables it will be noticed that the percentage of "arrested" cases at Sharon exceeds that of similar cases at Rutland. This brings us to a point of importance which has been touched upon at recent legislative hearings bearing upon the necessity or wisdom of establishing other state sanatoria in Massachusetts.

In making these comparisons it will, I hope, be unnecessary for me to state that it is not only my desire to get at the exact truth in these matters, but that my interest in both institutions is equally keen. The figures are made each year after careful consideration of each case regardless of previous records. What the reason may be of the somewhat more favorable results at Sharon I do not pretend to say absolutely, and any conjecture upon that point cannot be proven at present. The same class of cases are admitted in both places. Whether the closer individual supervision which is possible naturally for the smaller number at Sharon, is the cause, I cannot say, although it would seem to be a plausible explanation. While the results show only slight differences in the percentages,

yet the comparison is of interest for the one fact alone, that it confutes the statement made by an eminent Massachusetts physician at a recent hearing, (although he has had no personal experience in this direction, however,) that no sanatorium should ever be placed at a lower altitude than 1000 feet, a statement which I do not think is justified by facts. We have not yet had sufficient experience on these points to make such absolute statements, and yet from the results obtained thus far, I think I can justly say, that provided we have a well-selected locality, with porous soil and protected from the harshest winds, a moderate elevation of only 200 or 300 feet is quite as good as 1000 feet for our purpose. When it comes to much greater elevations of 4000 or 5000 feet, we look for greater physiological changes which may have a decided influence for good or bad upon individuals.

It must be borne in mind, that I am confining my remarks solely to what may be termed the local sanatorium treatment of tuberculosis for those who cannot for various reasons seek distant regions where the climate is especially salubrious. To this point I shall refer again.

SUBSEQUENT HISTORIES OF "ARRESTED" CASES.

The crucial test of any method of treatment lies in the permanence of its effects. Of the immediate benefit from sanatorium treatment for the great majority of cases there can be no doubt. Of the educational effect upon the community at large, and hence its influence upon the health of future generations, much has been said. I believe the good in this direction to be incalculable. Of the lasting effect upon the individual treated, time only can show proof. It is still somewhat early to get the full value of such statistics at Rutland and yet the large number of those who have been away from the institution from one to three years, and who are now active wage-earners again, many of them apparently being in robust health, is already sufficient proof alone of the value of the institution to the State. Circulars are frequently sent to former patients requesting knowledge of their present physical condition, their methods of life and other details of interest. Comparatively few are lost sight of.

In a paper before the American Climatological Society, at a meeting in New York in May, 1899, I gave the subsequent histories of patients who had left the Sharon Sanitarium with the disease "arrested," from 1891 to 1898. Of 34 "arrested" cases, six had died, the remainder being all alive and at the time apparently well. Of the six who had died, three had been fairly advanced cases at the time of entrance, in whom the "arrest" was unexpected. A return to unhygienic surroundings was

followed by a relapse. One died from another cause. Two, against advice after a considerable interval of good health under favorable conditions, returned to damp, unhealthy homes, where soon afterwards unfavorable symptoms again developed and death ensued. All the others at time of writing (1899), after intervals varying from one to seven years, had remained apparently well.

The replies to our circulars at Sharon from former patients during the past year only add to the favorable results, the tabulation of which I hope before long to give to the profession.

The study of these cases furnishes additional proof of the importance of a hygienic life carried on after the disease has been arrested.

METHODS OF TREATMENT.

At Sharon and Rutland the same methods are carried on as far as fresh air is concerned, the endeavor being to make the patient lead practically an out-of-door life every hour of the twenty-four, except at the time of rising and going to bed. Windows are never shut except at these hours. During a storm, the windows on the windward side are usually closed or screens covered with flannel are inserted in the casement. The cold is of course tempered by steam-pipes, but the warmest clothing is essential. It is astonishing to see how soon the patients become accustomed to this method of life and not only learn to like it, but even resent anything savoring in the least of a confined air in the rooms. The use of the cold plunge- or spray-bath in the morning, followed by vigorous rubbing in a warm bath-room, is one important feature of the treatment at Sharon and Rutland, which in the majority of cases is followed by marked increase of vigor in the patients. In this, as in all forms of treatment, there are, of course, exceptions to the rule if a proper reaction after the bath fails to appear. In such cases, sponging and rubbing of the chest is substituted.

Regulation of exercise is an important factor. Rest on reclining chairs in the open air is enjoined at first and gradually the patients are allowed to walk more freely, the injunction being given always to come back *before* they are tired and to "take two short walks rather than one long one." Care upon this point will often save a patient from an unnecessary rise of evening temperature, whereas infringement of the rule is a frequent cause of slight fever. In case of constant rise of temperature, absolute rest in bed with open windows is enjoined, and is usually followed by good results.

Three meals a day are served and a lunch of milk with or without

an egg is usually given between meals and before going to bed. Medicines are given as little as possible, an occasional tonic, or something to aid digestion, being the most frequent exception to the rule. Creosote in some of its forms has at times an apparent beneficial effect, but it is never given in the large doses recommended by some. Alcohol, in the form of wine or liquor, is forbidden except in very rare cases, my belief being more and more that the less it is used the better it is for the patient in the end. The old-fashioned method adopted by many, of advocating the free use of cod-liver oil and whiskey, I regard as worse than useless. As to the use of any so-called specifics, I may dismiss the subject by saying that I have found nothing thus far which in my hands has proved other than negative. It should be added that I have never used tuberculin therapeutically, not having been thus far convinced of its efficacy. As a means of diagnosis it is not infrequently resorted to, although I must confess to feeling far from satisfied with the results of its use for this purpose even. In short, I may state as my belief that while I still have faith that something may be discovered as a specific for the cure of tuberculosis, I know of nothing now to compare in efficacy to the absolutely hygienic life taught by sanatorium methods.

Will you allow me here to speak of a not uncommon form of carelessness, possibly excusable in the laity, but inexcusable in our own profession who should know better? I refer to the spelling of the words *sanatorium* and *sanitarium*. The use of the two words is unfortunate, doubtless, but we can at least remember that *sanitarium* comes from the Latin noun *sanitas*, and *sanatorium* from the verb *sanare*. Even in reputable journals the words not infrequently appear printed "sanitorium" or even "sanatarium," both being inexcusable errors among educated men.

Before closing, allow me to state my position as definitely as possible with regard to the establishment of sanatoria and hospitals for all classes of tuberculous patients.

As I have many times stated, having been for several years trying to use my influence in this direction, when the apathy upon the subject seemed almost hopeless, I have in the last few years, since the extraordinary change of attitude not only in the profession, but in the laity, felt myself standing in almost a conservative position lest extravagant claims and statements, especially by the lay press, should bring discredit upon the methods which have been so strongly advocated. It is largely for this reason that I have been so reluctant to call a patient "cured"; for I have seen not a few cases nominally "cured" that within a few months, or even much less time, have a sudden access of symptoms with fatal end-

ing. Almost inevitably a reaction of feeling takes place in the community and discredit is thrown upon the cause for which we are working.

As in every other walk in life, moderation in our statements should be cultivated. Fortunately I believe that the knowledge of the real good which can be accomplished is now so deeply seated in our profession as to prevent disaster to the cause; nevertheless caution in our statements is to be commended. I have never been one of those who maintain the idea that because of our success in treating tuberculosis in local sanatoria, there is no necessity for patients to seek more salubrious climates than our own. I have always held the belief that for *properly selected cases*, in our western health-resorts, there is a better chance for permanent cure of disease than in New England under ordinary conditions, provided the patient can find what is just as essential as good air, viz., good food and shelter, and provided the element of homesickness can be eliminated. I have always believed, moreover, that properly regulated sanatoria in better climates than ours would obtain better results than are possible here; but up to the present there has been a lamentable lack of such places in the west. For the hundreds and thousands who have not the means to go so far away and who for other reasons cannot be out of their own state, I regard such institutions as these in New England as of inestimable value.

In advocating the establishment of state sanatoria, moreover, they should, in my opinion, be used only for cases that are in the earliest stages of the disease. If patients with more advanced disease are admitted, they should be susceptible of such improvement as will make them wage-earners again. It should be kept in mind, moreover, that such rigorous treatment as is now given at Sharon and Rutland is not suitable for all cases. For elderly people, or for those whose powers of reaction are slight, no one should be so foolish as to advocate the extreme measures that are beneficial to people of more vigorous constitutions. I wish to emphasize this point, for in the popular enthusiasm upon the subject there seems to be an idea that the out-door treatment at all seasons, carried to its most extreme point, is suitable for everyone, which is not only Quixotic, but productive of harm to some patients. In certain cases I have urged the adoption of the same methods in a milder climate when I have seen a tendency to recurrence of attacks of general bronchitis, or where there seems to be a lack of reaction to the cold. On the other hand, in those who do respond to the treatment, the improvement is noticeably more rapid than when, as in earlier times, the fresh air treatment was not pushed to its present extent.

In conclusion let me say, that while I earnestly advocate the establishment of sanatoria for favorable cases by the State in suitable localities, I believe the erection of hospitals for the hopelessly sick in the immediate vicinity of our large cities and towns to be equally important. Suitable buildings for this purpose could be also erected by counties for villages and small towns which are too poor possibly to maintain independent hospitals of their own. These institutions should be under the care of the counties or municipalities to which they belong.

Fortunately, the community seems to be awakening to the fact of how much can be done to lessen the ravages of consumption, as shown by the numerous articles which appear in our medical journals and also in the daily press. As the "constant dropping of the water wears the stone," let us patiently and persistently work in these directions, and it is my firm belief that another quarter of a century will show us that our efforts have not been in vain.

AUXILIARIES IN THE TREATMENT OF CONSUMPTIVES.

BY OTTO JUETTNER, M. D., PH. D., CINCINNATI, O.

“Heilkräfte, nicht Heilsäfte.”

That the tendency toward abandonment of stereotyped drug-methods and toward the adoption and application of hygienic measures and other forms of drugless medication is becoming more pronounced every year, there can be no doubt. In a strictly scientific sense this is a most encouraging sign of the times. It indicates a leaning toward exactness of reasoning in the interpretation of disease and its manifestations and a more intelligent conception of the relative value possessed by the clinical weapons at our command. This change in the therapeutic attitude of the physician toward the clinical features of medicine followed in the wake of the many disappointments brought about by the ever-changing and never-ceasing fads and fashions of drug-treatment. This, however, was more in the nature of a coincidence. The true cause of the wonderful change in our ideas of treatment is to be found in the increasing importance which is given to the study of biology and the biological aspect of health and disease. We not only understand better the natural laws which govern the human body in health and disease, but have learned to be apprentices in the workshop of Nature. We have acquired more accurate knowledge of Nature's way of dealing with abnormal conditions and have learned to apply methods in imitation of and supplementing Nature's own peculiar efforts. It is not the treatment of any one disease that has been affected by this change in our therapeutic reasoning. The whole domain of clinical medicine gives evidence of new and more correct scientific thought. A more typical and characteristic example of this change of ideas could not be adduced than a synopsis of the modern therapy of that disease which represents the most common affliction of the human race, offering the greatest variety of symptoms and clinical types, namely the bacillary form of phthisis pulmonum.

In discussing the subject of lung-consumption and in considering the therapeutic agents which are at our command in the treatment of the disease, we must not lose sight of the two cardinal features of each and every case of this kind, to-wit: the infection in and of itself and the soil which made the development of the disease-producer possible. The bacillus *per se* means nothing unless we consider it in conjunction with

the necessary conditions which give it a chance to become the exciting cause of a consumptive process. The question of the treatment of tuberculosis would, therefore, resolve itself into the solution of two problems, viz: How can we attack the vitality of the bacillus itself and how can we render its dwelling-place as uncomfortable as possible or practically uninhabitable? These two problems must be solved conjointly. To wage war against the tubercle bacillus without rendering the soil sterile leaves the patient liable to reinfection. To give all our attention to the soil means to ignore the essence of the disease. In attempting to discuss some auxiliary agents which may help us in successfully overcoming the ravages of this murderous foe, their relative merits in a therapeutic sense can be best understood by considering them in relation to the double purpose of successful treatment mentioned above.

The question of rendering the bacillary cause of the disease inactive or of destroying it entirely, suggests itself as the first step in the treatment of tuberculosis. The bacillus thrives in lungs which are badly nourished. The less fresh air and rich arterial blood find their way into any particular part of the lung, the better are the chances for rapid and prolific growth of the germ. The oxygen in the air and in the blood is the natural enemy of the bacillus. The first and most important therapeutic indication is, therefore, the necessity of pure oxygen-laden air. In order, however, to become a powerful therapeutic factor the air must have a chance to enter the lungs, particularly those secreted and distant portions where the bacillus has found lodgment and thrives. The tuberculous patient's respiratory movements are shallow and do not expand the lungs as they should in order to aerate the infected portions. Consequently it is of importance to adopt measures which will deepen the respiratory movements. To encourage the patients to breathe slowly and deeply, especially out-of-doors, is of course of great value. The effect can be many times enhanced if additional care is taken to develop the muscular cover of the chest and to render the bony framework more elastic. In suitable cases the effect of procedures of this kind is well-nigh miraculous. I beg to briefly refer to them under the head of:

MASSAGE AND GYMNASTICS OF THE CHEST.

In order to understand the therapeutic value of massage it is proper to acquire the manual dexterity which alone enables us to form any opinion as to the possibilities of mechanical therapeutic methods. To manipulate the muscles of the chest-wall means to increase their blood-supply, to develop them, to render them stronger and more active. This, in and

of itself, means more vigorous respiration, especially if the mobility of the thorax proper has been increased. These effects should be aimed at in all cases of lung-consumption, especially during the early stages. The *modus operandi* is subject to variation owing to peculiarities of individual cases. In a general way the following suggestions will be found applicable to most cases :

The patient being placed in the dorsal decubitus the operator begins the manipulation over the costal border, gently picking up between his fingers a fold of skin and subcutaneous tissue, lifting it from the bony structures beneath and gently kneading it between his fingers. Most patients will be found to be "hide-bound," the soft tissues of the chest-wall being very tense and hard to raise. Eventually, i. e., after repeated sittings, the fold of skin will come up with comparative ease. This manipulation requires all possible patience and gentleness. Lack of delicacy would be worse than worthless. Gradually the manipulation is extended over the whole chest. This form of massage may be followed by gentle stroking in a horizontal direction. Each sitting should last from fifteen to thirty minutes, to be repeated after twenty-four hours. Within a week or two the muscles of the chest will be less tense and probably a trifle fuller. At this juncture exercise of the thorax might be begun. The operator places his flat hand over the right or left side of the patient's chest, making firm and gradually increasing pressure. The result will be a partial immobilization of a portion of the chest. If the patient is told to breathe deeply, the effect on the unengaged side of the chest will be more or less intense. The patient will expand the unengaged side of the chest more than he would without immobilization of the other side. The operator may alternately place his hand on one and the other side. He may vary the procedure by placing both hands on the lower portion of the thorax over the last three ribs, thus forcing the patient to expand the upper portions of the chest vigorously. In this way the expansive power of the chest can be increased considerably, rendering inhalation of fresh air a therapeutic factor of prime value. In applying these mechanical methods to individual cases, much depends upon the judgment and the individualizing faculty of the physician. With proper care and judgment an immeasurable amount of good may be derived from manipulations of this kind.

Oxygen, the germ-destroyer *par excellence*, is not conveyed to the lungs by the inhaled air alone. It is also carried by the arterial blood-current. Before discussing this feature of the problem, it is but natural to refer to the various attempts which have been made to increase the rela-

tive amount of oxygen which is taken in with every inhalation. *Oxygen-inhalation* is attracting considerable attention just now while the *ozone* idea seems to be very much in evidence among the country-practitioners who have invested in static machines and are generating ozone for their tuberculous patients to inhale. The prominence which has recently been given to oxygen as well as ozone justifies a short separate discussion of both subjects.

INHALATION OF OXYGEN.

Theoretically speaking, the inhalation of oxygen ought to be the ideal treatment of tuberculosis. It ought to, as it were, supply the missing link in the chain of vital elements which are antagonistic to the bacillus and its development. More especially ought this to be the case when the expanding capacity of the lungs is being increased by breathing exercises or by thoracic gymnastics. Clinical experience does not confirm this optimism of the theoretical physiologist. The absorption of oxygen is regulated by the physiological oxygen-carrying capacity of the blood. This again is in direct proportion to the relative number and quality of the red corpuscles. It is plain, therefore, that the forced introduction of oxygen into the air-passages does not necessarily produce an equivalent oxygenation of the blood. In order to arrive at distinctly physiological, i. e., curative effects from this method, oxygen must be not only inhaled but absorbed. The blood of a consumptive is wretchedly poor in oxygen, because the elements which carry it are poor in quality and reduced in number. Hence it is clear that the benefits of oxygen-inhalation are to a large extent illusory in character. Inhalation would have to be almost constant in order to make any impression at all. My own experience with this method in a variety of cases bears out what has been stated above. In cases of pneumonia, in otherwise healthy subjects, oxygen is an agent of magnificent virtue. I have seen cyanotic subjects, who seemed to be hopelessly gone, revive under the life-giving effects of oxygen. In these cases the physiological conditions are favorable to the utilization of oxygen in the animal-economy. In the consumptive subject the conditions for obvious reasons are not equally good. Then again, there is present in the organism that indefinable element which demands bulk or mass of physiological fuel rather than concentration or extraction. The experiments which have been made with concentrated food-elements as a pure unmixed substitute for food in bulk or mass, apply analogously to the problem of oxygen-feeding. The disappointments which have followed these experiments have demonstrated that the human body and the

test tube of the physiologist are two different things. The physiologist may define with mathematical precision the physio-chemical details of the process of nutrition. Yet, the conclusions of the laboratory do not hold good in the management of the living body. For reasons beyond our ken the lungs demand air and not pure oxygen. One day in the pure and dry climate of North Carolina is more than equal to all the pneumatic cabinets and oxygen-tanks to be found north of the 39th degree of latitude in the United States. Oxygen-inhalation should not be discarded as entirely valueless. It is of considerable service in a number of suitable cases. In addition to its action it is a psychical factor worthy of consideration. Then again, it gives the chest a gymnastic training which, as I have already had occasion to state, means a great deal in the management of a case. It teaches a patient to breathe deeply. In this respect all inhalation methods are entitled to some recognition. It is not the gas, the vapor, the medicated substance that does the work, but the steady attempt at lung-expansion which inhalation entails. If a patient has plenty of idle time, a few hours of assiduous oxygen-inhalation would undoubtedly prove of great value. The same statement, with some mental reservation, could be made in regard to ozone, which electrical manufacturers are pleased to designate as "concentrated oxygen."

INHALATION OF OZONE.

The popularity of the static machine has probably done more than any other factor toward bringing ozone prominently before the professional mind as an antituberculous remedy. Every static machine has its ozone-generating attachment and the enthusiastic owner of such a machine never wearies of extolling the virtues of ozone. That the enthusiasm of these men has given rise to many an extravagant claim in its behalf, it is quite natural to suppose. After considerable experimentation with ozone I am led to believe that there is but little clinical evidence to recommend it. The odor of the gas, not unlike that of chlorine gas, is disagreeable to many persons. Unless the gas is largely diluted with air, it is very irritating and can hardly be borne by the average consumptive. If it is administered in a badly ventilated room, the procedure is of questionable value. Ozone is in no way superior to oxygen as an inhalant and possesses many disagreeable features which oxygen does not. After all, it is the mechanical act of deep respiration wherein lies the good of any inhalation method.

The subject of the generation of ozone by a static machine suggests the clinical uses of the high-tension or high-voltage currents in the treatment of tuberculosis. The electric energy produced by friction manifests

itself by the generation of currents possessing but little volume (amperage), but an extremely high degree of electro-motive force (voltage). This high degree of tension may be raised still more by causing the current to pass through a coil until an almost incredible number of "alternations" is reached. This kind of high-voltage currents is known as a "high-frequency" current and the coil which is used in generating it, as a "high-frequency" coil. This form of electric energy is destined to play an important part as a therapeutic agent in the near future and merits more than a passing notice.

HIGH FREQUENCY CURRENTS.

For the production of a high-frequency current we need a generating source of high voltage (static machine or induction-coil), a condenser (Leyden jars or specially constructed accumulator of electric energy) and a coil giving many thousands of "alternations" per second. The two cords attached to the binding-posts of the high-frequency coil are connected with an insulated platform and to a glass electrode respectively. The patient is placed upon the platform. The electrode is a glass vacuum-tube of variable shape and size to suit the surface to be treated. As soon as the current is turned on, the interior of the glass-electrode is aglow with a beautiful blue light. When the electrode is brought near the patient's skin, the current passes through the glass in the form of innumerable fine needles which play on the patient's skin with a distinct crackling noise. There is no pain connected with the procedure. When the electrode is in firm, close contact with the skin, there is no noise, no sensation of any kind. Yet the electro-motive force of this current represents hundreds of thousands of volts.

The most peculiar and at the same time most valuable therapeutic property possessed by this current is its strong affinity for oxygen. Whether it is proper to speak of a chemical affinity for oxygen I am not quite certain. There is no doubt, however, that oxygen accumulates in the pathway of a high-frequency current. Whether the electric energy liberates some of the oxygen of the tissues or whether it merely draws arterial blood by dilating the arteries, I am not prepared to say. The fact remains that arterial pressure is increased by the passage of a high-frequency current. The tissues become actively hyperaemic, even the smaller vessels responding to the stimulus. If the electrode is applied to the chest, the exhaled air of the patient soon has the peculiar odor of ozone. A tendency towards hæmorrhage would, of course, be a contra-indication to the use of a current of this kind. Subjectively the application of the high-frequency current is followed by a feeling of buoyancy

and ease. Dyspnoea is very promptly relieved. The effect of a treatment of fifteen minutes lasts for hours. While the dearth of clinical evidence makes it impossible to form any definite opinion at this early date, there seems to be no doubt that the local application of this form of electric energy has much to recommend it. As a palliative agent its claims to therapeutic recognition are well established. It relieves pain promptly, especially muscular pain (pleurodynia). In this respect the high-frequency current is equal to the best analgesic means at our command. The next decade is bound to see the development of this new and wonderful subject.

The consideration of high voltage electric energy in the treatment of disease suggests the therapeutic possibilities of an equally new and promising agent, to-wit: the therapy of light (sun light and electric light).

PHOTOTHERAPY.

The sanitary importance of light has been clearly established by the epoch-making labors of Finsen and his pupils. We are ready to admit that light and bacterial life are in inverse ratio to each other. I do not wish to quote in detail the conclusions to which the biologic researches and experiments of Finsen have led. It seems to be established that light is a germ-killer *par excellence*. In its action on the surface of the body it has a distinctly penetrating translucent power which makes it a health-preserving factor of great virtue to the whole organism. Finsen proved that light penetrates the skin and tuberculous tissues, that it facilitates the assimilation of oxygen, that it preserves the corpuscular elements of the blood. The importance of light on the vital processes within the animal economy has been attested by Moleschott, Piacentini and many others. It has been shown that the absorption of oxygen as well as the secretion of carbonic acid is increased and accelerated by light and diminished and retarded by darkness. It has been demonstrated that light will augment the quantity of hæmoglobin. There can be no doubt, therefore, that light represents a therapeutic factor of enormous importance in the treatment of consumption. The sun-bath of the old Greek physicians has received the scientific sanction by the photo-therapeutists of recent years. That the rays of an electric arc-light possess some of the power of sunlight, especially through the instrumentality of the chemical fields of the spectrum, is well known. The body of a consumptive should be exposed to light as much as possible. In the local treatment of consumption, the use of concentrated chemical rays (Finsen) is surely destined to become a therapeutic feature ere long. In view of the great germicidal

power possessed by the chemical rays of the sun or the arc-light, it is reasonable to suppose that in suitable cases of tuberculous infection of the apices much can be accomplished by the employment of these rays. I have at present two of these patients under treatment. They are placed under the light-generating source and given an hour's exposure daily. The light falls on the skin and covers a space $1\frac{1}{2}$ in. square, corresponding to the location of the apex within. The technique of the application is the same as ordinarily employed by photo-therapeutists. While it is too early to speak of any definite result in the two cases under treatment, there is no doubt that both patients are improving. How much of the improvement may be attributed to the action of the ultra-violet light is, of course, a matter of conjecture.

The modern therapy of consumption includes two other factors which I beg to briefly refer to. It seems that no therapeutic discussion nowadays is complete unless the *Röntgen rays* have come in for a share of consideration. Whether they possess a well-established claim to clinical recognition in the treatment of tuberculous infection, I am not prepared to say. The reports on this subject are so inaccurate and confused that it is impossible to arrive at any conclusions. If the use of *X* rays were confined to the hands and to the judgment of thoroughly competent observers, a great deal of valuable and reliable clinical information might be gleaned. It may be stated, without great fear of contradiction, that in the treatment of lung-consumption little, if anything, is to be expected from the subtle rays of Röntgen.

Last, but not least, *hydrotherapy* should not be lost sight of in the treatment of tuberculosis. In the modern sanatoria of Europe the treatment of consumption rests on a tripod, to-wit: air, light, water. Some form of hydiatic procedure is applicable in every case of tuberculosis.

In conclusion I beg to state, that I am very much of an optimist in regard to the tuberculosis problem. I look upon this dire and murderous affliction as being the logical punishment which nature metes out to those who sin against certain fundamental principles. The offender may be an individual, a family, a tribe, a race. It would lead me too far to elaborate upon these biological points. In the struggle for existence the fittest is bound to survive. Appease outraged Nature and the ban is lifted. I believe that tuberculosis can be stamped out, if we treat the individual, and educate the race. The solution of the problem lies in the popularization and application of practical physiology and hygiene.

REPORT OF THREE HUNDRED AND NINE CASES OF PULMONARY TUBERCULOSIS WITH REMARKS ON CLASSIFICATION AND TREATMENT EMPLOYED.

BY KARL VON RUCK, M. D., ASHEVILLE, N. C.

Medical Director of the Winyah Sanitarium.

The cases which form the basis for the present report have been treated in the Winyah Sanitarium during the years 1901 and 1902. In previous reports a short detailed synopsis of each case has been given for the purpose of comparison of the condition of the patient on admission with that at the time of discharge. These details, although occupying a great many pages had nevertheless to be given in so condensed a form that the advantages desired were realized in but a small degree, and when a like method in the present series was found to require from fifty to sixty pages, it was abandoned in favor of a more general consideration of similar cases, which would permit the devotion of more space to coëxisting tuberculous affections and complications. The former division of the clinical material is adhered to and as regards this I wish to say to those who are not familiar with earlier reports, that the classification is not based upon the degree and extent of the local changes in the lungs, but rather upon prognosis in which all the factors entering into the prospective result had necessarily to be considered. Thus cases have been included in *Class A* in which caseous softening or excavation was present or in which infiltrations in the larynx, or gastro-intestinal and other affections existed as complications. In such instances, however, the local destructive changes were, as a rule, circumscribed and the belief was justified that they would remain limited, while in regard to the other prognostic features the patient's chances were considered good.

Although in some respects the prognosis was deemed much less favorable in the cases included in *Class B*, either because of the extent and degree of local pulmonary alterations or because of coëxisting complications, impairment of nutrition, etc., there were other indications of a fair prospect for obtaining arrestment or radical improvement.

Like considerations governed me in the assignment of cases to *Class C*. The majority of the cases of this group were admitted to the Institution conditionally, and in all of them the outlook appeared serious and

quite doubtful, but not to such a degree that decided improvement or eventual arrestment of the disease was necessarily precluded.

To these explanations as to classification of cases on admission, I may add that while a division into stages or classes anatomically or prognostically is more or less arbitrary and is often liable to error owing to our inability to fully recognize, by the physical signs, the actual anatomic changes existing in the lungs, which a histological examination of the tissues would reveal, we may still err in an estimate of the final result in so far as this depends upon the constitutional resistance and recuperative powers of the individual patient, upon the latter's personal conduct, self-control and coöperation, and upon the occurrence of complications that can not possibly be foreseen. The reason for this is at once apparent when we consider that restitution in the absolute sense must be the rarest exception, if indeed it ever occurs, and is certainly impossible in all those cases in which any degenerative or destructive change has taken place in the involved area, no matter how completely physical signs may have disappeared, and how completely and lasting the disappearance of symptoms and the restoration of the general health of the patient may be. The total disappearance of physical signs of anatomical alterations occurs but rarely and when we interpret a continued harsh inspiratory murmur, or prolonged expiration or bronchial character of respiration as indicative of cicatrization or fibroid changes, no one can tell us if such an area does or does not include caseous tubercles that may undergo softening and disintegration at some future time. Although a cavity may have been observed to decrease in size and to have remained free from all moist sounds, and although the cavernous respiration may have become more and more obscure, because of compensatory emphysema of adjacent lung-tissue, who will warrant that caseous tubercles are not situated in the walls of such an apparently healed cavity, liable to soften with the first recurrent inflammation of its interior, which may accompany the next attack of infectious bronchitis to which such a patient is no less liable than are other persons? Again who shall say that the walls of an apparently healed cavity are not traversed by pervious blood vessels which may rupture and give rise to severe hemoptysis?

Obviously we can speak of a recovery from tuberculosis only in a clinical sense, but even in this respect there are scarcely two observers who would classify their results alike, and it has happened more than once that a patient considered by one physician as having attained a clinical recovery was advised to undergo subsequent and prolonged treatment by another, who was not conversant with the clinical course of the disease in the par-

ticular case, and who gave his advice simply upon the recognition of structural alterations in the patient's lungs which no amount of treatment could cause to disappear.

If such advice should be considered an error, what shall be our attitude in cases in which in the absence of subjective symptoms, changes are found present upon examination, in a localized tuberculous area that may be slowly progressive, or more or less latent for the time being? Surely it would be a mistake to pronounce such a patient even apparently cured. But few physicians, comparatively speaking, are able to draw so fine a distinction from auscultation only, that they would be enabled to decide so important a question in the best interest of the patient, and should one be rash enough to accept such a state as satisfactory, and as requiring no present attention, he is liable to deprive the particular patient of his best chances for saving himself from advancing to a more serious stage of his disease.

These and additional considerations which readily suggest themselves to the experienced physician, make it evident that a detailed acquaintance with the previous clinical course can only prevent us from committing error and enable us to form an approximately correct judgment of our patient's condition and necessities, unless we have recourse to a tuberculin test as a criterion for a clinical recovery.

With my present experience in regard to this test, both for purposes of diagnosis and determination of results obtained from any method of treatment, I am strongly in favor of its application in all doubtful cases at least, as the only means of certain recognition of the early formative stages of tuberculous invasion, and of determining the presence or absence of a clinical recovery. This test may also be applied in cases which have received tuberculin preparations for their therapeutic effect, and more particularly is this true if the preparation has been one derived from the bodies of tubercle bacilli rather than from the culture fluid as is the case with Koch's original tuberculin (*tuberculinum crudum*).

If crude tuberculin has been the therapeutic agent and no recent reactions, either local or general have been observed, under increasing doses in a case in which there is otherwise evidence of a clinical recovery, and it is desirable to determine the presence or the absence of tuberculous tissue capable of reacting, the treatment should be suspended for several weeks, and a dose about 20% larger than the last therapeutic dose should be given after most painstakingly recording the auscultatory phenomena in the chest, or the local evidence, etc., existing in other parts. If neither

local nor general reaction can be shown, it will be safe to conclude that a clinical recovery has obtained.

When the watery extract of tubercle bacilli has been the therapeutic agent, the test should be made with crude tuberculin. I have heretofore expressed the belief that this preparation differs materially in the nature of its toxins from the latter, and within the last year have had additional confirmatory evidence in this respect in the occurrence of decided reactions to minute doses of crude tuberculin, in patients under treatment with the extract, although the latter was given in relatively much larger doses, and without the production of reactions. If in cases treated with this preparation an apparent clinical recovery has been attained, a test with 5 mg. of crude tuberculin will, in my opinion, decide the necessity for further treatment or the absence of tuberculous tissue, the precautions being the same as in all other tuberculin tests.

In all cases which have been treated without culture products, or with anti-tubercle or anti-phthisic serum, derived from supposedly immunized animals (horse or goat), the tuberculin test as commonly recommended for diagnostic purposes may be resorted to at any time when a satisfactory clinical result is otherwise in evidence. A like course should be followed in all those cases in which no clinical symptoms are present and in which pathologic alterations of any kind suggestive of tuberculous origin are discovered by physical examination of the chest, especially when the physical signs suggest only fibroid changes. A judicious and careful course like this which appears to me entirely free from objection on the ground of possible harm, if adopted by many observers, would soon show its practical value, not only in bringing about uniformity of results reported, but also in a better understanding and estimation of particular remedies and modes of treatment applied. In this connection it should nevertheless be stated that not even a negative tuberculin test would fully assure us that the patient will thereafter remain free from relapse unless a new infection occur, for we know that encapsulated caseous tissue does not react to an ordinary test dose of tuberculin and that very small foci of any kind of tuberculous tissue may not reveal their presence in the organism either by the occurrence of fever, or by any local evidence, especially when deeply situated in internal organs. It would, however, remove doubt in many cases, and serve as a standard for a clinical recovery better than any other criterion.

Laboring under the theoretical misapprehension that the tubercle bacillus extract, when given therapeutically in larger doses without causing reactions, would establish toleration to the toxins of

crude tuberculin also, I have heretofore not tested with crude tuberculin immediately upon completion of treatment, cases in which extract had been employed, and which had apparently recovered, but have thought it necessary to postpone such a test for about six months, by which time any toleration which had been acquired would necessarily be lost. This course has made the test possible only in a limited number of discharged patients, for, as a rule, such patients went to their distant homes, and although requested to do so, comparatively few returned thereafter to prove their recovery, so long as they felt well and were free from symptoms. In the future it is my purpose to apply a tuberculin test in all cases in which I feel justified in the belief that a complete arrestment or apparent recovery has been obtained, and regardless of the method of treatment that may have been followed. For the reports of results obtained in the past, I can only say that in some one hundred and fifty cases tested at periods varying from six months to twelve years, during which no further treatment was applied, I have seen but very few reactions, and that I remember at the present time but two instances of this kind. That the results which I have claimed heretofore have been conservative and generally reliable appears from these occasional direct confirmations by personal examination and non-reaction to a full test dose of tuberculin; also from replies to direct inquiries, through correspondence with patients, or with physicians who referred them to me, and from voluntary reports which show enduring results. In many instances cases reported only as "greatly improved," have suffered no relapse and might therefore have been included in the apparently recovered class.

Proceeding now to the details of the present report, the clinical material to be considered consists of three hundred and nine cases of pulmonary tuberculosis divided as follows:

| | | | | | | | | | | | | | | | |
|----------------------|-------------------------|-----|-------------------|-----|----------|-----|------------------------|-----|-----|---|---|---|---|---|----|
| <i>Class A:</i> 53. | Apparent clin. recovery | 48. | Greatly improved | 3. | Improved | 2. | Grown worse or died of | | | | | | | | |
| | | | Disease arrested. | | | | | | | | | | | | |
| <i>Class B:</i> 139. | " | " | " | 73. | " | 43. | " | 23. | " | " | " | " | " | " | 0 |
| <i>Class C:</i> 117. | " | " | " | 41. | " | " | 23. | " | 24. | " | " | " | " | " | 29 |

It should here be stated that all the improved cases were pursuing a favorable course when they left the Institution prior to their actual discharge and had they been able or willing to give additional time such improvement could reasonably have been expected in many to lead to the same degree as was attained in the cases which apparently recovered. In a large number, in fact, a satisfactory issue has either been subsequently attained under the care of the home physician, or is prospective from their further improvement.

WEIGHT.

| | | | | | |
|---|-------|-----|--------|---------|---------|
| In <i>Class A</i> , All patients gained, varying from | 4 lb. | to | 35 lb. | Average | 11½ lb. |
| In <i>Class B</i> , " " " " " " | 7 " " | " " | 52 " " | " " | 16 " " |
| In <i>Class C</i> , 90 of 117 patients " " " " | 2 " " | " " | 41 " " | " " | 12 " " |

Five patients gained and lost weight thereafter, showing no loss on discharge. Four patients neither lost nor gained; eighteen patients lost weight steadily.

In many instances the patients continued to lose weight in the early period of their treatment, owing to the active, febrile stage in which they were admitted, and their gain was really more than here appears.

TUBERCLE BACILLI.

Class A: Tubercle bacilli were present in the sputum on admission in twenty-eight cases and appeared on subsequent examinations in nine others. On discharge tubercle bacilli were absent or there had been no sputum in forty-eight; of five cases (improved) there was no expectoration in two, and tubercle bacilli were present in three cases.

Class B: Tubercle bacilli were present in all. On discharge eighty-nine had either no sputum or tubercle bacilli were absent.

Class C: Tubercle bacilli were present in all but one case. Sputum had disappeared or tubercle bacilli were absent in forty-nine cases, on discharge.

NIGHT-SWEATS.

Class A: Fourteen cases had night-sweats which disappeared in all.

Class B: Night-sweats were present in greater or less degree in fifty-two cases on admission; on discharge this symptom was present, but in a less degree and only occasionally, in but one.

Class C: Night-sweats were recorded in sixty-six cases on admission and in eleven cases on discharge.

Chills more or less marked were present in *Class A* in eight cases, and in *Class B* in thirty-nine cases, but disappeared in all. In *Class C* chills were present in forty cases; disappeared in thirty-two cases; became slight and occurred only occasionally in eight cases. These latter cases were among those which followed otherwise an unfavorable course.

It may not be without interest to give now the details of the frequency and degree of other tuberculous affections coexisting with the pulmonary disease, and of the various complications on the part of other organs, and their outcome.

TUBERCULOSIS OF THE LARYNX.

Of the three hundred and nine cases the diagnosis of existing tuber-

culous infiltration or ulcerations could be made from inspection in one hundred and eighty-two of which twelve belong to *Class A*, eighty to *Class B*, and ninety to *Class C*. Local reaction occurred to tuberculin preparations in eighty-four others, of which twenty-two belong to *Class A*, forty to *Class B* and twenty-two to *Class C*.

From this it appears that evident tuberculosis was present in over fifty-eight per cent. of all cases, and adding those in which local reactions to tuberculin were observed, we have a fraction over eighty-six per cent. which is a strikingly large proportion, as compared with my former records, as well as with the experience of other observers, or even with the results of post-mortem examination of tuberculous subjects. When, however, we inquire into the number of cases in which the tuberculous lesions found in the larynx had reached such a degree as to cause changes in the voice or local discomfort our proportions are not out of harmony with the common experience as will be seen from the following table :

| | |
|---|----|
| Tuberculous infiltrations diagnosed on admission, but giving no symptoms..... | 81 |
| Tuberculous infiltrations with slight degree of ulceration, mostly superficial, and giving but slight symptoms..... | 39 |
| Tuberculous ulceration and infiltration causing decided subjective symptoms. | 62 |
| Tuberculous infiltration of slight degree, doubtful, reacting to tuberculin..... | 84 |

A further explanation for the unusually large percentage lies no doubt in the fact that this subject has received much closer scrutiny and attention in the throat department of the institution since the publication of my last report than it did before, and at the same time these figures suggest the probability that in a considerable number of cases the laryngeal disease is either recovered from spontaneously, or at least never reaches a degree that would attract attention by post-mortem appearances, even if the patient succumbs to his pulmonary affection. On discharge the local conditions of the larynx were as follows :

INFILTRATIONS.

| | | |
|---|-----|-------|
| Complete disappearance of all evidence, and non-reactive to tuberculin in... | 114 | Cases |
| Diminution in degree, with more or less local thickening, but non-reactive to tuberculin in..... | 65 | " |
| Breaking down with subsequent cicatrization of ulcer, some local thickening remaining, not reacting to tuberculin in..... | 11 | " |

ULCERATION.

| | | |
|---|----|-------|
| Present on admission, healed during treatment, leaving more or less thickening, not reacting to tuberculin..... | 36 | Cases |
| Infiltrations improving, but still reacting to tuberculin..... | 8 | " |
| Not influenced by treatment, practically stationary or slightly improved..... | 12 | " |
| Grown worse..... | 20 | " |

Other tuberculous affections of the upper air passages occurred in : *Class A*, in one case of a tuberculous ulcer of the cartilaginous nasal septum in which the diagnosis was confirmed bacteriologically and by local reaction to tubercle bacilli extract ; this cicatrised under the continued use of the latter without other interference except keeping it clean.

Class B. Two additional cases of the same nature were treated, resulting in complete healing, without the occurrence of perforation, and a case of tuberculous ulceration of the naso-pharyngeal vault in which the bone was laid bare, granulated and healed.

In *Class C*, occurred one case of tuberculous perforation of the nasal septum which granulated and healed, likewise a case of tuberculous abscess of the faucial tonsil which was evacuated surgically and curetted, and healed thereafter. In this class are also to be recorded two cases of tuberculous suppuration of the middle ear in which a great diminution of the discharge, but no improvement as regards the existing loss of hearing of the affected side was accomplished.

TUBERCULOSIS OF LYMPH GLANDS.

Tuberculosis confined to the cervical lymph glands occurred in eleven cases; axillary and cervical in four cases; axillary glands alone, bilateral in three cases, unilateral in two cases; axillary and inguinal glands in two cases—a total of twenty-two cases. More or less decided local reaction occurred in all these cases, although not in every one of the enlarged glands. In addition glandular reactions under the therapeutic use of watery extract of tubercle bacilli occurred in several others of which no particular record has been kept. In the reacting glands diminution in size occurred regularly, but only in a few instances was the result so complete as to cause the enlargement and induration to disappear entirely; none of the glands suppurated, and reduction in size occurred, also in instances in which no local reaction was ever noted. In one case with enlarged axillary glands, one of them had suppurated before the patient entered the institution, and the ulcer had healed with a purplish cicatrix at the lower edge of which there was a fistulous opening, discharging slightly and at irregular intervals. Under a well marked reaction the cicatrix broke down in part and the discharge became more profuse; complete healing followed.

TUBERCULOSIS OF THE GENITO-URINARY ORGANS.

There were three cases of tuberculosis of the testicle, one in *Class B*, and two in *Class C*. The former was decidedly improved, inasmuch as the pain disappeared and there was a great reduction in size as well as in

the hardness of the involved part. In one of the other cases the testicle was removed; examination showed the process to have reached the state of caseous softening. The operation wound closed, there has been no relapse nor extension to the opposite side, while the seminal vesicles, prostate, bladder and kidneys continued free from suspicion of disease. In the third case the testicular disease occurred in connection with an acute general miliary tuberculosis, and the patient died of tuberculous meningitis.

Another case, also belonging to *Class C.*, in which all evidence tended to confirm the diagnosis of tuberculosis of the left kidney, except that no tubercle bacilli were found in the urine, made a gradual recovery from symptoms under the use of urotropin.

OTHER COMPLICATIONS.

Digestive organs: Diarrhœas, which on account of persistence in spite of dietetic measures, and because of the presence of locally circumscribed pain and tenderness on pressure, blood in the stools, etc., were looked upon as tuberculous, existed in six cases in *Class B* and in sixteen cases in *Class C*. Complete subsidence of symptoms or radical improvement occurred in all excepting four cases of *Class C*, in which no lasting influence could be accomplished.

Rectal fistula was present in two cases of *Class A*; both healed without operation. There were also three cases in *Class B*, of which one healed and two improved; and three cases in *Class C* of which one improved and two continued without material change.

Gastric catarrh, atony, etc., were complications in two cases of *Class A*, and in eleven cases of *Class B*, all of which were completely relieved by proper dietetic and local measures, the latter consisting in gavage, galvanic or faradic current. Of twenty-two cases belonging to *Class C* nine were entirely relieved, six were greatly improved and three improved.

Diabetes was present on admission in three cases of *Class C*; in two the tuberculous disease made rapid progress with equally rapid deterioration of the general condition, and both cases were returned to their homes, where they grew worse and died. In the other case the amount of sugar present was small, and could be controlled almost entirely by proper regulation of diet. This patient lost his sugar permanently and suffered no recurrence on the resumption of an ordinary mixed diet.

Diazo reaction was present in a marked degree in two cases of *Class B* and in forty-five cases of *Class C*. It disappeared permanently and the patients improved or recovered in both instances of *Class B*, and in twenty-

five cases in *Class C*. It disappeared and recurred several times in slighter degrees in four others of *Class C* without apparently interfering with general or local improvement. It persisted in sixteen cases of this class all of which failed to improve or grew worse.

IMPORTANT COMPLICATIONS WHICH AROSE DURING TREATMENT.

Pneumonia occurred in fourteen cases; in connection with suppurating cavities in seven, and in previous tuberculous areas with recognizable cause in two, in connection with pulmonary hæmorrhage in five. Resolution occurred without subsequent breaking down of the pneumonic area in nine and in these the subsequent course of the disease did not appear to be influenced for the worse, but in five others in which the pneumonia occurred subsequent to hæmorrhage, the involved area broke down and the cases followed an adverse course thereafter. In all these cases the pneumonic process was sufficiently extensive to be demonstrable by physical examination; cases of slighter degrees in which the diagnosis was conjectured only, are not here included.

Pulmonary hæmorrhage occurred in thirteen cases; slight in five, moderate in two and severe in six; all of the last were followed by pneumonia and with one exception pursued an adverse course. In the exceptional case the pneumonic area cleared up and the patient again improved.

Meningitis: In one case of *Class C*, death was due to tuberculous meningitis.

TREATMENT.

It still remains to say something of the methods of treatment which have been applied. Of these the dietetic and hygienic measures have had precedence over everything else, and I am as firm as ever in my conviction that, as in all other serious diseases, such measures must form the basis of all therapeutic endeavors. Their value in the treatment of phthisis has never been questioned, and they constitute the only general method on the necessity and importance of which there is uniformity of opinion. The open air treatment really belongs to this method, whether it is applied at the patient's home or at a climatic resort, inasmuch as there can be no proper personal hygiene that does not take cognizance of pure air and sunlight. In the application of the latter, however, I have seen no occasion to subject my patients to severe inclemency of weather, nor to inaugurate a system of hardening by exposure to conditions under which persons in ordinarily good health frequently contract more or less

serious disease, and which no patient would be likely to maintain after his discharge, even if he had been fortunate enough to have survived the ordeal while under treatment. On the contrary I find that in this respect there is the greatest necessity for the exercise of common sense and judgment, and that, if individualizing in the management of phthisical patients in the various stages, phases and complications of their disease is essential anywhere, it is so in the regulation of physical exercise and of out-door life according to the state of the weather, temperature, etc.

With such individualization and with the strict enforcement of all general dietetic and hygienic measures, as well as of all particular directions given to the individual patient, under the unremitting supervision of a properly trained medical staff, I am of the opinion that I am obtaining all the benefits derivable, and the results which I have recorded furnish better evidence for the correctness of my views than does the relation of isolated instances in which patients have apparently done well in spite of injudicious management.

The Use of Culture Products of the Tubercle Bacillus.

My further experience with the present series of cases in almost all of which the watery extract of tubercle bacilli has been employed has in no wise changed my opinion as to the value of culture products in the treatment of tuberculosis, and I am gratified to note that the prejudice which followed the employment of Koch's original tuberculin after its first introduction is gradually disappearing both in regard to its diagnostic and therapeutic uses. A remarkable uniformity of a favorable attitude was a striking feature in the discussion of the subject at the British Congress, and favorable reports and opinions in the current literature are now the rule rather than the exception, if we compare it with that of eight or ten years ago. While excessive doses and bad selection of cases were the chief reasons assigned for the failures which were recorded at that time, there is, in my opinion, another and perhaps equally important factor which conduced to the formation of adverse judgment as to the value of these remedies, namely the expectation of the removal of certain local evidences of disease and of the symptoms due thereto, upon which tuberculin preparations can have no possible influence, excepting perhaps for harm when excessive doses are followed by severe local and general reaction. Ideal results in the complete cure of patients by culture products alone can be reasonably expected only in cases of recent, purely tuberculous disease in which none of the degenerative changes of caseation, softening and excavation has occurred.

It must be obvious to the reader that a caseous tubercle, when it has attained an easily visible size is not removable by any but a mechanical means, and that at best its penetration and encapsulation by connective tissue with resulting pressure atrophy is all that can be expected, and only then when the general nutrition of the patient is still good, and when the caseous tubercle is comparatively small. If we should, therefore, not expect the complete disappearance of caseous tubercle without a trace of its previous presence, we have in tuberculin preparations, nevertheless, a remedy which through stimulation of the adjacent tissue favors the occurrence of connective tissue formation, and therefore aids nature in making of such tubercle the best possible disposition. What the mode of action may actually be when the non-degenerated, gray or translucent miliary or submiliary tubercle entirely disappears, is of course beyond the possibility of demonstration, and all we can say is that such tubercles are absorbed. This I have quite often witnessed under the influence of tuberculin upon visible mucous membranes and in tuberculous affections of the skin, and I have also noted the return of a normal vesicular respiratory murmur in areas which the persistent presence of a rough "sticky" inspiratory murmur, or of a murmur accompanied by fine crepitation, with or without interruption in rhythm, caused me to believe to be the seat of such tubercles. In this opinion I have had confirmation by former experiences in examinations, after death, of lung portions which gave such evidence shortly before. Like observations have been possible in portions of lung in which the physical changes were more decided and which nevertheless returned to a normal condition as far as external examination could determine.

I have always been most careful in my physical examinations to note and record my findings accurately upon a diagram corresponding with the chest, by which I can control the changes in percussion and auscultation as they take place between certain periods, at a particular locality. I have by this method been enabled to follow the advances of tubercle into adjacent lung portions which formerly gave no evidence of alteration from the normal respiratory murmur, and I have further been able to confirm the correctness of my records by anatomic and histologic examinations sufficiently often that I am inclined to the belief that my interpretation of the results of my examination is, as a rule, correct. In many cases so examined and recorded, I have noted the gradual extension of the disease from a circumscribed portion of an apex to the entire lobe, and to the opposite lung, and I have never witnessed the spontaneous retrogression of the process without the administration of tuberculin

preparations, whereas with their use I have, as a rule, seen no such extensions, but the gradual return to normal conditions of areas already so involved. By these observations I am confirmed in the opinion that in the lung as well as upon visible surfaces, recent tubercles disappear under the use of the tuberculin preparations. For such results decided local reactions must be avoided; if they nevertheless occur frequently or in rapid succession, which was much oftener my experience from the use of Koch's original tuberculin than now from the watery extract of tubercle bacilli, then the receding area follows, as a rule, another course as regards final return to normal vesicular respiration. In such case the inspiration becomes and remains more harsh and deficient in the soft, breezy vesicular quality, while the percussion note which previously was full and deep, becomes of shorter and of a slightly higher pitch, a change in all probability produced by connective tissue formation in the particular locality, the growth of which has been stimulated by often repeated and decided local reactions.

While such a result is not unfavorable, and as far as I have been able to observe is equally enduring, I nevertheless prefer a return to perfectly normal conditions. As far as these are demonstrable with the stethoscope I find I can succeed much better with the watery extract of tubercle bacilli, and am not so frequently taken unawares by severe or decided local reactions as I was when I administered the old tuberculin.

Only when the tuberculous areas have gradually assumed normal conditions and these adjoin closely the areas of the decided dullness, the seat of fibroid changes and cavities, do I push the remedy to the production of recognizable local reactions, and even then I avoid their frequent occurrence. I do this in the expectation of still further increasing or inducing connective tissue changes with a view of establishing a firmer barrier to possible later advances, and of inducing subsequent shrinking and retraction in such a locality.

These I consider the therapeutic results obtainable from culture products when painstakingly and intelligently applied; at all events I have obtained them very uniformly in the cases which I have treated, and I have in not a single instance seen any unfavorable effect, although I have probably applied these products in more cases than any other observer, having thus far reported 1339 cases of my own.

In this connection I wish again to call attention to the evidence of endurance of results which I have reported. These I have had opportunity to verify by physical examinations, personally, by the tuberculin test, or through subsequent correspondence. Comparison of the per-

manency of these results with that of series of cases which were treated without tuberculin preparations inclines me to assign an important influence to treatment with the class of remedies under consideration.

Under these circumstances, and in the light of my own experience and that of a constantly increasing number of observers, I feel it my duty to give my patients the benefit of such treatment in addition to every other method that has been found of value. To those who still harbor fear and misgiving, my work should at least show that I have done no harm, and that I have succeeded clinically in most serious as well as in favorable cases to a degree that compares well with any other series of cases as will appear from the following table of results, in the consideration of which it should not be forgotten that a still better record would no doubt have been obtained if the patients could all have been kept under treatment for a sufficient length of time.

The following table of the 1339 cases, including the 309 of the present series, shows the total results obtained by treatment with culture products, as compared with those obtained in 816 cases in which culture products were not employed.

| | Cases Reported | Recovery | Improvement. |
|--|----------------|----------|--------------|
| Koch's original tuberculin | 379 | 35.5% | 37.5% |
| Modified tuberculin (various preparations) | 348 | 38.0 " | 48.0 " |
| Watery extract of tubercle bacilli | 612 | 54.2 " | 36.0 " |
| Treated with culture products (total cases) | 1339 | 42.6 " | 40.3 " |
| Treated without culture products (total cases) | 816 | 12.1 " | 31.0 " |

In considering these statistics it must not be forgotten that of the cases reported more than one-third were in far advanced stage, many of whom suffered from serious complications. In comparing these results with those of other institutions that admit only early stage cases which correspond to our *Class A* only this class should be considered. Were we, however, to include even our *Class B* for such a comparison we would still obtain a showing very much in favor of the combined methods of treatment as applied in the Winyah Sanitarium. The last 106 cases in *Class A* showed a recovery in 91.5 per cent. and improvement in 8.5 per cent; in *Class B* there were treated during the past four years 219 patients of whom a clinical recovery could be assumed, on their discharge, in 56.6 per cent. and improvement in 43.4 per cent., not a single case in these two classes having failed to make satisfactory progress.

The treatment of tuberculosis of the upper air passages and ear has been conforming to the well established procedures consisting in careful cleansing and in local applications of lactic acid, menthol, orthoform and

other astringents for cases presenting advanced lesions, whereas for the slighter degrees of ulceration and for all infiltrations, as well as for all glandular affections, I have depended upon the general hygienic, dietetic and climatic features of management and upon the culture products referred to. In all visible local tuberculous affections no dose of the latter was given except in the light of the local effect and any observed reaction was allowed to subside completely.

In intestinal tuberculosis (obstinate diarrhoeas supposed to depend upon the presence of ulceration) dietetic measures were naturally first resorted to; when these failed medication was employed either locally when the seat was in the large intestine, or by the mouth, if the affection were located higher up, or both. Of all the remedies which have given the best result I must again mention iodomuth, and xeroform, which were frequently combined with large doses of bismuth subnitrate, ten to fifteen grains of the former to one to two drachms of the latter, three or four times a day.

The treatment of fever consisted chiefly in the enforcement of absolute rest, except in instances of high degrees of pyrexia when hydropathic measures were resorted to, or an occasional small dose of thermol was employed.

In this connection I desire again to emphasize, as I have done on many former occasions, that the true antipyretic in phthisis is absolute rest in bed, when the temperature materially exceeds 100°F , or quietly reclining out-of-doors with lower elevations of short duration. However desirable a fair and judiciously regulated amount of exercise may be when the temperature has reached a constant normal course, neither physical nor mental exertion can be allowed as long as fever is still a symptom unless we wish to take the risk of greatly protracting the duration, or of actually jeopardizing the result of treatment. Few patients submit willingly to the necessary control unless they are severely ill, or are suffering from acute complications, but none fail to appreciate the benefit after they have submitted to this great essential in the successful management of the active stages of the disease. Fever, even when not excessive, often begins with chill, or slightly chilly sensation. When the chill is decided, the patient suffers in proportion, and the temperature is thereafter always higher than it is when by proper measures the chill or chilly sensation is prevented. The best measure is absolute rest in bed, and if this does not succeed unaided, then the patient should be particularly guarded against any draft of air, or cooling of the cutaneous surface; nothing cold should be allowed for food or drink, for at least one hour before the expected

time for its recurrence, which is, as a rule, quite regular at a certain hour of the day. In addition the patient should receive a hot drink, if necessary with a stimulant and should be well covered, a hot-water bottle being placed to the feet ; these precautions to be taken at least an hour before the chill is expected and the hot drink being repeated if necessary. It is a rare exception when with these measures the chill is not avoided or at least greatly modified even at the first trial. These measures must be kept up on successive days for at least a week, when they may be gradually relinquished, especially if the record shows a normal temperature for several hours beyond the time when the chills previously occurred. It is a great error to abandon such precautions too quickly, and rest in bed preceding any rise of temperature that may occur in such a case at a later hour of the day, should be persisted in for several weeks. Such a course can not only advance the patient's convalescence and the advent of an afebrile course by weeks and months, but may become the basis for a recovery that otherwise could not occur. There is also much gratification in the results to the managing physician, when by so simple means a most distressing and often unfavorable symptom yields so nicely to his painstaking efforts, and few patients fail in appreciation and gratitude.

The Treatment of Pneumonia.

All the cases reported were treated with large doses of creosote carbonate, while at the same time hot poultices of flaxseed were applied. From the additional experience afforded by these cases, as well as of several others seen in consultation, I am greatly pleased with my results. In addition to the fact that the pneumonic areas did not break down, as is so commonly experienced in the forms due to mixed infection to which all my cases belonged, the creosotol seemed to have an unmistakable influence on the fever, especially when large doses were given.

Treatment of Hemoptysis.

In the mild cases nothing beyond dietetic measures and rest were employed. Gelatin injections were made in the severe and recurrent forms of hæmorrhage and were frequently repeated, but without any apparent benefit. In all cases but one, hæmorrhage was finally controlled under the use of local application of ice, and of morphia sufficient to control excessive cough, while saline cathartics were employed when it appeared necessary to reduce the blood pressure.

Treatment of Cough.

My further experience confirms my former statements, that the

direct treatment of this symptom becomes necessary the less frequently, the more painstakingly the general management of the case is carried out. In those instances in which interference was deemed necessary, that is when moist warm inhalations and proper local treatment of affections of the upper air passages, and local counter-irritation over evidently congested lung-areas did not give sufficiently prompt relief, Glyco-heroin or small hypodermic injections of codeine were prescribed with satisfactory results.

Treatment of Marked Anæmia.

As heretofore, all that could reasonably be expected, was accomplished with Peptomangan and a satisfactory improvement in the percentage of hæmoglobin as well as in the blood-count was the uniform result. The remedy was always well borne, and an improvement in appetite was often the first evidence of its favorable effect.

Various other methods of general and local treatment have been given a trial during the past two years. Our results were negative from inhalations of formaldehyde, likewise from the internal administration of urea.

ORIGINAL TRANSLATIONS.

A CONTRIBUTION TO THE SYMPTOMATOLOGY AND PATHOGENESIS OF CASEOUS PNEUMONIA.

BY PRIVATE DOCENT TH. G. JANOWSKY AND PROFESSOR W. K.
WYSSOKOWICZ OF KIEFF.

CLINICAL HISTORY AND REMARKS BY PRIVATE DOCENT JANOWSKY.

The question as to the connection between tuberculosis and pneumonia has excited the interest of physicians for a long time. Even at the time when the diverse forms of tuberculosis were not united under one etiologic basis, this question evoked a number of investigations and differences of opinion. Some, with Laennec at their head, considered the caseous pneumonic process as the expression of the same disease which in other cases manifests itself by the formation of tubercles in the miliary form. Others, among them NIEMEYER,¹ VIRCHOW,² and JACCOUD,³ assumed that cheesy pneumonia represents an independent inflammatory process upon which tubercles can develop later on, but that cheesy process can not be regarded as the sequel of a tuberculous lesion. Since a criterion for the exact determination of the nature of the process has been found in the discovery of the tubercle bacillus by Koch, the chronic caseous pneumonias are unquestionably recognized as secondary, and the development of tubercles is considered as the primary, essential lesion.

While this question has been sufficiently cleared up as regards the nature of chronic caseous pneumonias, the same can by no means be said of the acute caseous form, which is termed cheesy or tuberculous pneumonia (*pneumonia caseosa*, or *tuberculosa acuta*). What phase of this disease should be regarded as primary, and what development of it as secondary, is to this day entirely unknown. For this reason the study of individual cases of this disease, of which the following is an instance, is of importance.

M. K. G., was born in the Government of Kieff, seamstress, aged twenty years; entered the hospital on November 30, 1899. She had been ill for about three weeks, the last of which she spent in bed. According to her statement she had had fever and cough during the entire period of illness. She could not give any definite information as to any previous illness.

On examination she was found to be of middle stature, with a good

skeleton, a weakly developed muscular system, and a marked atrophy of the subcutaneous adipose layer. Her skin was pale, with well marked cyanosis, as were also the external mucous membranes. No eruptions were noted either upon the body or upon the extremities. Her consciousness was perfectly normal, save a slight depression. The pupils were of equal size and the reaction to light was good; no asymmetry was found in the face. The mucous membrane of the oro-pharynx was slightly hyperaemic, the tongue was covered by an extensive light-brown coat, but was not dry. The mucosa of the lips was very dry. The respiration was shallow, regular in rhythm, about 40 per minute.

On examination the lungs showed dullness of percussion on the left side from the middle of the scapula downward. Over this area the vocal fremitus was distinctly increased, and on auscultation we found loud bronchial breathing and crepitant râles. No changes were found in the remaining lobes of the lungs, except a few dry ronchi. The sputum was tenacious, rust-colored, and was repeatedly examined; neither on admission nor a week later did it contain tubercle bacilli. On the other hand Fraenkel's pneumococci were found at each examination.

The apex of the heart was found to be in the fifth intercostal space, and its impulse could be distinctly seen. The upper limit of the absolute cardiac dullness was at the fourth rib; on the right side the limit of relative cardiac dullness was about half a finger's breadth distant from the margin of the sternum. On auscultation no murmurs were heard at any of the valvular points but an exaggeration of the second sound was detected over the pulmonary artery. The pulse was of sufficient fullness and size, soft, with a regular rhythm of from 100 to 110 beats per minute.

No noteworthy deviations from the normal were observed on examining the abdominal viscera; the liver was not enlarged, nor was the spleen. The border of the liver could not be felt. The abdomen was moderately distended; the abdominal walls were soft, not painful on palpation, and no gurgling sound could be elicited in the ileo-caecal region. The faeces, passed only after enema, were of normal consistence. The urine was yellow, concentrated, faintly acid in reaction; specific gravity 1.020, contained only traces of albumin, no sugar, no bile-acids and no bile-pigments. On standing it deposited a slight cloud, which on microscopical examination, proved to contain only flat epithelia from the vagina, in small numbers. Ehrlich's diazo-reaction was well marked.

As regards the further course of the disease, it may be stated that the pulmonary signs remained practically unchanged throughout the entire time of observation, with the exception of the last twenty-four

hours, when oedematous râles were heard in both lungs. In the same way, no changes could be noted on the part of the heart and the pulse until the last day. But on that day symptoms attesting to a lowering of the cardiac activity developed, namely a change in the qualities of the pulse, without any disturbance of rhythm. In general, the chief signs of progress to the worst were only the rapid emaciation, the increase in the apathy and the general weakness of the patient, as well as the cyanosis. Death came on Dec. 16th, after the development of increasing cardiac weakness, terminating in paralysis of the heart. The autopsy, performed by Professor Wyssokowicz on December 17th, showed an almost completely generalized caseous pneumonia of the left lower lobe, a few smaller foci in the other parts of the lungs, and an old scar with small calcified foci in the upper lobe of the left lung.

It appears that in the present case we had to deal *ad vitam* with a series of diagnostic signs which spoke in favor of a croupous (lobar) pneumonia—a high temperature of a constant type; the limitation of the lesions to one lobe; exaggerated vocal fremitus, dullness on percussion, loud bronchial breathing, crepitation, a typical rust-colored sputum, and the presence of Fraenkel's pneumococcus. Two signs were present, however, which did not permit us to be content with the diagnosis of lobar pneumonia; viz., the prolonged duration of the illness and the marked cyanosis. The patient had entered the hospital three weeks after the beginning of the disease, so that the usual time for the decline of the temperature of a lobar pneumonia had already elapsed, and the fever continued during the $1\frac{1}{2}$ weeks of the patient's stay at the hospital. The crisis may be delayed in lobar pneumonia, and may be postponed for a number of weeks, especially in weakened and cachectic persons. According to SÉE⁴ a retardation of the crisis does not continue longer than for three or four weeks, so that, according to his opinion, the absence of the crisis is a diagnostic sign of the presence of another pneumatic process—a cheesy, tuberculous lesion. In the present case the time set by SÉE had scarcely elapsed, so that the possibility of a cheesy pneumonia was admissible, but yet there was no absolute contradiction against the diagnosis of croupous pneumonia.

Another sign, cyanosis, is of greater importance. It is, of course, not remarkable that cyanosis may occur in lobar pneumonia, but marked degrees of it are not observed in this form, except in cases in which a large area of lung is affected, or in which the heart's action is disturbed. In the present case the cyanosis could not have referred to either of these causes, and yet it was so marked that it attracted attention from the very

first. In our case the lobar affection was confined to the left lower lobe, while all other lobes were clear or at least did not present signs of distinct disease. The examination of the heart showed no organic changes nor was there a sufficient degree of cardiac exhaustion to account for the marked cyanosis. The qualities of the apex beat, and of the pulse-wave, the sufficient size, fullness, and the regular rhythm of the pulse, the distance of the limit of the relative dullness on the right side, half a finger's width from the right sternal border, as well as the accentuation of the pulmonary second sound all tended to remove this possibility. These cardiac signs were only the effects of a disturbance of the lesser circulation by the infiltration of the lower lobe of the left lung.

The suspicion arose, therefore, that there existed some process in this case, which impeded the exchange of gases in the lungs, namely an acute tuberculous pulmonary affection. It is well known that in some cases of acute tuberculosis the clinical signs are so indistinct, that the diagnosis can only be made as regards the existence of symptoms of a disturbance in the exchange of gases. Sometimes, as GRAVES⁵ noted, these signs form the entire clinical picture of acute tuberculosis, so that as he suggests, they may be called properly "tuberculous asphyxia." The clinical signs of disturbed gaseous exchange, dyspnoea and cyanosis, do not always run parallel to each other, and in our case the dyspnoea was not marked in a degree corresponding to the pronounced cyanosis, and the frequency of the respiration was only from 35 to 40 per minute. It is true that dyspnoea predominates in the clinical picture of acute tuberculosis, but according to TRAUBE⁶, Sée and others a very important place should be given to cyanosis among the symptoms of the disease in question.

In returning to our case, we may say, that what has been stated affects it only indirectly, for in admitting the possibility of a tuberculosis of an acute character, there could have been no question here of an acute tuberculosis which bears the name of "tuberculous pneumonia." Traube says concerning this form that: "When it occurs uncomplicated, it never produces cyanosis, in spite of the large area of lung infiltrated—in contradistinction to acute miliary tuberculosis which produces a marked blue coloring of the cutaneous surfaces. Fraenkel and Troje, and lately ELLING⁷, are of the same opinion. As a result, the diagnostic value of cyanosis as a symptom of cheesy pneumonia was lost to a certain degree in the present case, although the thought as to the possibility of this process could not be banished, and required corroboration by other symptoms which serve in the differential diagnosis of cheesy pneumonia

from the ordinary lobar type. GRAUCHER⁸ lays particular stress, on the one hand, upon heredity and on the debility which precedes the disease, and on the other hand upon the peculiar onset of the disease. In our case nothing definite can be stated as regards the first of these factors, but as regards the onset this period resembled closely the initial stage described by Graucher as typical for cheesy pneumonia. This author maintains that a premonitory period precedes the seemingly sudden onset, and that marked local and general symptoms, or even only general symptoms may be observed during this stage. He assumes that this period corresponds to an exacerbation of the preëxisting tuberculous process. The onset, which appears sudden to the patient and which for him marks the beginning of the disease, denotes the onset of the pneumonic process which occurs as a reaction of the surrounding tissues to the irritation induced by the exacerbation of the tuberculous process. Our patient counted the onset of her illness as beginning a week before her admission to the hospital. As a matter of fact she had been sick for two weeks, during which she was scarcely able to be about.

Before we pass on to the auscultatory signs it may be mentioned that the diminution in the intensity of vesicular breathing is regarded as characteristic of cheesy pneumonia in contrast to croupous or lobar pneumonia, according to HERARD, CORNIL and HANOT⁹. They believe that bronchial breathing does not occur in this disease (cheesy pneumonia), and when it is observed it is faint and of short duration; but the cases of GRAUCHER, JACOUD, LACCAUD and MAYGRIER,¹⁰ and those of DREYFUS, BRISAC and BRÜHL,¹¹ prove that bronchial breathing does really exist, and is well marked in cheesy pneumonia, although not so loud and sharply defined as in lobar pneumonia. In our patient we could hear neither diminished vesicular nor diminished bronchial respirations; on the contrary, only loud bronchial breathing was heard. This seemed to contradict directly the assumption that a cheesy pneumonia existed, and yet that disease was found present at the autopsy.

In order to understand this apparent contradiction, it must be borne in mind that in cheesy pneumonia we usually have a combination of pneumonic and tuberculous infiltrations, each of which may take part in the lesion in a varying degree in the individual case, and if the pneumonic element gains the ascendant, the conditions are made favorable for the same auscultatory notes as are heard in true lobar pneumonia, namely bronchial breathing. In the same way we can explain the occurrence of crepitant râles in our patient, while Herard, Cornil and Hanot believe that in cheesy pneumonia subcrepitant râles are heard and not crepitant

râles as in lobar pneumonia. The same opinion is also expressed by Sée.

We may be misled into assuming the presence of a pleuritic exudate by the occurrence of diminished vesicular or diminished bronchial breathing, existing together with a dull percussion note, which must be recognized as a sign that, though constant, is not very important in the differentiation of cheesy pneumonia.

The exaggeration, or at least the undiminished intensity of the vocal fremitus will here, however, serve as a point of distinction, the importance of which was pointed out by Monneret, and one which is considered by Herard, Cornil and Hanot as the first and most important differential factor of the diagnosis of cheesy pneumonia. It must be said, however, that even this sign has no absolute value, for cases of cheesy pneumonia have been observed with diminished vocal fremitus (Maygrier). According to MARFAN¹² this occurs as the result of a coincident pleuritic exudation, or without the involvement of the pleura, in the same way as in spleno-pneumonia. In consideration of these facts, Graucher warns us against absolutely diagnosing a pleuritic exudate, when the vocal fremitus is diminished. In our case the presence of fluid in the pleural cavity did not hinder the increase of vocal fremitus, as the amount of exudate was found too small even at autopsy, and when we consider post mortem transudation, still less fluid must have been in the pleura during life.

The characters of the sputum are supposed to be of great importance in the differentiation of cheesy pneumonia. The sputum is usually mucopurulent, but may be mixed with blood.

It does not have the rust-colored appearance that is so characteristic of lobar pneumonia (Marfan). In our case, however, it had the typical rust-color and was very tenacious, characters that may again be explained by the predominance of the pneumonic process in this instance.

The presence of Koch's tubercle bacilli in the sputum is regarded as a still more important factor. According to PERCY KIDD¹³ the only facts on which a positive diagnosis of cheesy pneumonia may be based in doubtful cases are the presence of signs of softening and the finding of tubercle bacilli in the sputum. But if a positive result in the examination of the sputum decides in favor of a diagnosis of cheesy pneumonia, the absence of tubercle bacilli from the expectoration cannot be said to exclude the presence of this disease. The fact of the matter is, that tubercle bacilli occur in the sputum, only when the areas of lung affected with tuberculosis soften and empty into the lumina of the bronchi. If, on the other hand, the process goes on so rapidly that the tuberculous foci have not had time to soften, then the conditions for the appearance

of tubercle bacilli in the sputum are lacking. In cheesy pneumonia the presence of tubercle bacilli in the sputum is noted as a rule toward the end of the second week, according to Graucher. Our case, in which they were not found on repeated careful examinations, even a month after the beginning of the illness, simply proves that this period is of no particular consequence, and that a negative result on examination of the sputum for Koch's bacilli does not by any means exclude cheesy pneumonia. It is true, the bacilli reach the sputum also from old foci, which merely serve for the further spread of tuberculosis, but these foci may be so small in size and so insignificant in the number of bacilli which they throw off that no bacilli can be found in the sputum. So it was in our case.

On the other hand, the examination of the sputum in our patient showed the presence of Fraenkel's pneumococcus, and the same germ was found on repeated examinations. This fact was of great pathological importance, as will be shown by Professor Wyssokowicz's communication.

We conclude our brief review of the salient clinical signs in our case by mentioning the rapid emaciation which was noted in our patient, and that may also be numbered among the differential points in favor of cheesy pneumonia and against lobar pneumonia (Marfan, Percy Kidd).

This review shows how the clinical picture of cheesy pneumonia may vary, and how little positive diagnostic value can be attached to the different symptoms. Our case especially showed loud, bronchial breathing, tenacious, rust-colored sputum, the absence of Koch's bacilli in the sputum even more than a month after the beginning of the disease, and finally, contrary to the assertion of Traube, a well marked cyanosis. The last mentioned condition is of importance to our understanding of the pathogenesis of the dyspnoea and the cyanosis of acute tuberculosis. Since the time of Graves, we have understood this dyspnoea to be due to the compression of the alveoli by large numbers of tubercles which form in the lungs. Observation showed, however, that in some cases of miliary tuberculosis the number of tubercles found in the lungs on autopsy was far smaller than had been thought from the intensity of the dyspnoea. The dyspnoea, therefore, was explained in another way—as the result of the irritation of the pneumogastric nerve (Herard, Cornil and Hanot). Both these theories deal with that form of acute tuberculosis which is accompanied by the formation of miliary tubercles, and do not explain the disturbance in gaseous exchange which is observed in the pneumonic form of acute tuberculosis. In the latter the affection often involves only one lobe, as in lobar pneumonia, and all the other parts of the lung may remain sufficiently free and aerated, as was the

case in our patient, and yet it happens that the dyspnoea and cyanosis are incomparably more marked than in a lobar pneumonia. Therefore we must look elsewhere for the cause of the disturbances in gas exchange, not only in tuberculous pneumonia, but also to a certain extent in miliary tuberculosis. Probably this cause will be found to reside in some action of the toxins of tuberculosis which are developed in over-abundance in these cases, and which for example lead to a diminution in the number of red cells in the blood. These toxins perhaps produce a more profound disturbance in gas exchange in the tissues themselves.

AUTOPSY BY PROFESSOR W. K. WYSSKOWICZ.

The following conditions were found at the autopsy on the body G.:

The body is of medium size; the muscles and the subcutaneous fatty tissue are poorly developed; the abdomen is sunken; the general emaciation is marked.

The stomach is small. The liver projects to about three fingers, breadth beyond the edge of the ribs and a very small quantity of a thick, opaque, yellowish fluid can be scraped from its surface. The transverse colon is stretched somewhat downward and slightly elongated. The great omentum is atrophic, its right extremity is adherent to the peritoneal coat of the Fallopian tubes. Slight, fibrous thickenings are found on the left broad ligament of the uterus, and similar thickenings and pseudo-membranes are found in the region of the appendix and at the free border of the ileum at its termination. The intestines are not distended with gas. The serous coat of the small intestine appears reddish on account of the distension of the blood-vessels, which is especially marked at the free border, where the coils touch one another. The apex of the diaphragm is found in the fourth intercostal space on the right side, in the fifth on the left.

Both lungs are partly adherent to the chest-walls by thin, loose transverse adhesions. The right lung shows old adhesions, the left fresh ones. About 300 c. c. of a turbid, yellowish, serous fluid is found in the left pleural cavity. The lower lobe of the lung is markedly enlarged, so that its apex is compressed and is slightly displaced inward. A denser adhesion is found between the lung and the thoracic wall at the junction of the lower with the upper lobe. The consistence of the lower lobe is firm, and it has a mottled appearance because a number of yellowish spots of the size of a pea and of an irregular polygonal shape, shine through its covering which is coated with a thin, fibrous pellicle. On section the tissue is free from air, and consists almost

exclusively of slightly granular, dry, cheesy, pea-sized islands of yellowish color, and of a few larger ones with irregular rounded form. In some places in the lower portion of the lobe these foci lie so closely to one another that only narrow pink lines can be seen between them. In other places these bands are larger, grayish-red in color, gelatinous, atelectatic, and œdematous. Solid nodules, resembling the cheesy, grey, grain-like foci, can be felt in places in the upper emphysematous lobe. On section purulent, softened cavities with thin walls filled with cheesy clumps and a pus-like mass, appear at the posterior border of the lower lobe. These cavities have no communication with the bronchi. At the site of the firm adhesion spoken of above, there is a depressed scar in the centre of which appears a cavity with calcified masses, of bony consistence, which seem to be lying free in the scar tissue. Similar cheesy foci are scattered in the right lung, especially in its lower lobe, at times single, at times in small groups, but in general in much smaller numbers and much smaller in size than in the left lobe. The majority of these foci are reddish-gray, granular, and only in the central portions yellow and cheesy. The bronchial glands are a little hypertrophied, in places pigmented; in other places the tissues are relaxed and of a grey color.

The heart is approximately of normal size; its right ventricle is a little enlarged, the walls of both are thin, the heart-muscles pale, the valves unchanged. In both chambers there are some clots and a little fluid blood. The intima of the aorta is without special changes.

The spleen is normal in size, its capsule a trifle clouded, and slightly thickened. Two spots of dirty grey color are seen at its upper and outer border. On section these areas are found to be foci of the size of a walnut, of a dirty, reddish-grey color, contrasting markedly with the dark red back-ground of the surrounding tissues which are somewhat firmer than is normal, and which can be scraped away only with difficulty.

The liver is somewhat atrophic and on the surface of its capsule a fairly large number of small fibrinous pellicles are noted. In some places nodules, greyish in color, and of the size of a hemp-seed or smaller, shine through the capsule. Here and there the outlines of a liver lobule are visible. On section the tissue is muscle-like, yellowish-brownish-red, in color; of normal consistence, and shows in places a few indistinctly circumscribed foci of the size of a hemp-seed.

The kidneys are of normal size, the capsule is easily detached, and there are a few yellowish spots with red margins on the surface of the parenchyma. These are found on section to be wedge-shaped areas of the size of a pea or bean, yellowish, with red margins. On section the cortex

is reddish-greyish in color ; the pyramids are whitish, sclerosed. The pelvis of the right kidney is somewhat dilated ; the ureters are unchanged.

The stomach shows small dark-red spots in its mucosa, and some superficial erosions due to hæmorrhage. The contents of the colon and the lower part of the small intestine is dark, dense, apparently mixed with blood ; the mucosa of the small intestine is hyperæmic, though thin and atrophied. The rectum shows no changes beyond hyperæmia and atrophy.

The vagina has a rough mucous membrane and at its introitus, on the posterior wall, there is a wound 1 cm. in diameter, with callous, cicatrizing, partly pigmented edges. This wound is closed by a suture in one place.

The cervix of the uterus shows cicatricial depressions in two places. The uterus itself is somewhat enlarged, its mucosa smooth, a trifle sclerotic, its walls yellowish, hyperæmic.

In the brain there is venous hyperæmia and a slight cedema. The bones of the cranium are thickened and somewhat sclerosed.

Epicritical Remarks on The Autopsy.

An old tuberculosis with calcified left lung. Fresh cheesy broncho-pneumonia of both lungs, more marked on the left side, and serous pleurisy on the left. In addition, traces of an old peritonitis, as well as a fresh peritonitis of a mild type, existing in the region of the capsule of the liver and spleen as the result of suppurating infarcts. Infarcts of the liver and spleen. Parenchymatous degeneration of the heart, with dilatation of the right ventricle.

On microscopical examination sections from the lungs showed the appearances of a cheesy pneumonia. The pea-sized yellowish areas proved to be formed of finely granular structureless masses, in the centre of which there were, in places, indistinctly defined, also granular areas which corresponded to the old miliary tubercles. Around these areas were seen, the further from the centre the more distinctly, the outlines of pulmonary alveoli, with necrotic granular walls and exudate. The peripheral portions of these foci showed the appearance of a gradually spreading cheesy pneumonia, with slight thickening of the alveolar walls, moderate hyperæmia and an exudate that filled the alveoli and is typical of these pneumonias. The typical characters of this exudate were revealed in the irregular distribution of the same with fibrin-network that was more marked in some places than in others. A more or less considerable admixture of desquamated pulmonary epithelia and to a lesser degree of polynuclear

leucocytes was visible everywhere. The fibrin-network was not so delicate as that met with in a lobar pneumonia, but was thicker, apparently oedematous. The lesion most characteristic of cheesy pneumonia, however, was the gradual necrosis of the pneumonic areas, which involved not only the contents of the aveoli but also the partitions between these spaces. At first this necrosis appeared with nuclei incapable of staining with the dyes used, but with the outlines of the cells and the exudate still faintly marked. Later everything was converted into a homogeneous, finely granular structureless mass, in which traces of preëxisting outlines of alveoli and tubercles could be seen only with difficulty under low magnification.

Staining the sections by Ziehl-Neelsen method showed the presence of tubercle bacilli, as well in the completely necrosed areas as in the still fresh exudate of the alveoli, within the endothelial cells. The number of these bacilli was not constant. In some places there were more, in others none could be seen. In the fresh exudate there were very few, in places, here and there, for the most part isolated. In addition to tubercle bacilli Gram's stain revealed a large number of diplococci, evidently Fränkel's, although these were not as uniform as in ordinary fresh croupous lobar pneumonia.

We had to deal, therefore, in the present case, without doubt with a pulmonary tuberculosis followed by a cheesy localized pneumonia surrounding the tubercles which had become totally necrosed. As regards the pathogenesis of this lesion, it is perfectly clear and certain that a mixed infection of tubercle bacilli and Fränkel's diplococci played a rôle in this case.

In this respect the case is all the more interesting, inasmuch as no tubercle bacilli were found in the sputum during the patient's life, in spite of the fact that repeated examinations were made by my colaborator who is experienced in this work. On the other hand, Fränkel's diplococcus was found even during the patient's life, also in repeated examinations, and even the sputum had assumed the rust-colored appearance so characteristic of lobar pneumonia. The post mortem examination which showed the presence of a large number of Fränkel's diplococci, perfectly accounts for the cause of the finely granular cheesy pneumonia with which we had to deal.

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ON THE MEASURE OF EXERCISE IN THE TREATMENT OF PULMONARY TUBERCULOSIS*

BY PROFESSOR PENZOLDT, ERLANGEN.

A most gratifying consensus of opinion exists on most questions concerning the dietetic, hygienic and sanatorium-treatment of tuberculosis in its incipient stages. It is generally recognized that life in the open air is more beneficial than confinement in badly ventilated rooms, and while it is admitted that tuberculosis of the lungs can heal in any climate, yet it is not to be denied that some climatic conditions, for example those offered by mountainous regions, present advantages above others in the treatment of this disease. Since the fear of excess in dietetic regimen has proved somewhat exaggerated, and since it has become the object of every rational physician to avoid all excesses that may prove injurious, there is no great difference of opinion as regards the value of a plentiful nutritious diet in tuberculosis.

There is, however, one important question upon which, in my judgment, there is still too great a diversity of opinion, and that is the amount of exercise permissible in the individual case. It is only natural that in discussing this theme, I should begin with the consideration of a recent article by DETTWEILER¹, for this author's merit in having first emphasized and proved the necessity of rest as a part of the newer treatment of tuberculosis, cannot, in my opinion, be too highly estimated, and his views on this subject are therefore of especial significance. But on account of their weight, these views should not be allowed to go unchallenged wherever they are assailable. The very sentence in which Dettweiler explains the motive of his communication is, in my judgment, subject to criticism. He says: "I felt the necessity of protesting against the now so prevalent exaggerated fear of all exercise". This statement is the more to be criticised, because Dettweiler quotes those who, like Turban, Cornet, and myself, agree with him as regards the value of rest, but not those who are in favor of sparing the patient every unneeded motion.

The reasons which brought me to this point of view will be apparent from that which is to follow. For the present I may mention only a few. We still hear too frequently the statements of patients with incipient

*Translated for the *Journal of Tuberculosis* from the *Münchener med. Wochenschrift*, Jan. 6, 1903.

1 DETTWEILER: *Zeitschr. f. Tuberkulose u. Heilstättenwesen*, I, S. 96, 180.

phthisis that their physicians advised them to "walk a great deal", and too often indeed do we see tuberculous persons creeping along in evident exhaustion. Even in climatic resorts and institutions do we see such mistakes, and I may be believed in this respect without mentioning names. Intelligent patients have often complained to me that the exercise demanded of them in sanatoria tires them. In the mountainous neighborhoods of some sanatoria one can often see persons who are unmistakably seriously affected, taking long and rapid walks. Even in grave cases, patients in sanatoria have been known to fail to keep their accustomed quick exercise within bounds, as soon as they believed themselves unobserved. In the "order of the day" of one sanatorium, a daily afternoon walk for an hour and a quarter was enjoined. A patient who had been leading a sedentary life necessitated by his occupation was compelled in one institution to saw wood for two hours daily. Such examples, observed in various sanatoria—and I could easily mention more—make me think that the "prevalent fear of all exercise" is insufficiently developed rather than exaggerated. I admit that there are sanatoria where great caution is observed as to the exercise of the patients, but I cannot call this caution exaggerated even in these institutions.

The thing to be most desired, of course, is the determination as objectively and as considerately as possible of the amount of rest to be enjoined and the amount of exercise to be permitted in each case. Such a determination is not sufficiently emphasized in Dettweiler's discussion of the subject. We gain, however, the distinct impression, that he would not abandon caution even in those cases in which he would go further than Turban, for example, in the allowance of exercise. In this, as in other things, we must trust the *master* in the treatment of tuberculosis, but shall not the disciples interpret his words as meaning an amount of exercise that would prove too great for the patient? For this reason an attempt should be made to determine, as exactly as possible, the measure of exercise to be prescribed.

Inasmuch, however, as it is impossible to give absolute rules for the physician's guidance in this respect, simply because the course of tuberculosis is uncertain, it is judicious to answer first the following question: Can we in a doubtful case injure the patient more by too much rest than by too much exercise? It is believed that too little exercise, especially too little respiratory exercise, too shallow breathing, produces a deterioration of the entire organism, and particularly of the affected pulmonary tissues, through the deficient exchange of gases and through the disturbances in circulation which result. The reasons for this belief are fully

set forth in Dettweiler's article. I cannot recognize the logical force of these arguments because the premises are not quite correct. We are dealing, in the consideration of this question, for the most part with incipient, curable cases of tuberculosis, with normal, slightly elevated, subnormal, or labile temperatures. It has never been proved, to my knowledge, that these youthful persons who, as a rule, are strong, actually do not breathe deeply enough when they are at rest and are not exercising their respiratory muscles, and that they thereby injure their nutrition and their pulmonary tissues. As a matter of fact, it is very improbable that such is the case. There is absolutely no reason to assume that the reflex excitability of their respiratory centres is diminished, as it can be in the later stages. In incipient phthisical patients the lack of oxygen will excite respiratory movements by virtue of the contact of the blood with the medulla oblongata, just as in healthy persons at rest. The only possibility of a respiration that is too shallow for the demand of oxygen may be found in cases in which the breathing is painful. This, however, is not the case in the majority of the incipient, uncomplicated instances of tuberculosis, much to the patients' actual detriment, as otherwise they would sooner seek the advice of a physician. On the other hand, dyspnoea is frequently seen in the early cases, and the increase in the frequency and depth of the respirations which is observed, especially after exertion, which cannot be explained in these early stages by a diminution of ærating surface of the lung, must rather be interpreted by an over excitability of the respiratory centre. It is to be expected, therefore, that when the patient is at rest, there is also a sufficient automatic respiratory excitability.

The extensive experience which I had the opportunity of obtaining bears out this view. In the polyclinic we are consulted by incipient phthisical subjects, as a rule because they have been prevented from working, chiefly on account of the fever which troubles them. In such cases we prescribe generally, in addition to an abundant milk diet, only rest in bed with an open window. The result is seen often after a few weeks in the shape of a normal temperature and an improvement in the patient's nutrition, so that sojourn at a free sanatorium becomes possible, thus keeping up the improvement already gained. With this mode of treatment, it was possible to check the disease after it had existed for months, provided the patient followed directions, even in cases in which the prognosis seemed hopeless when they were first seen. The fact that formerly when we did not realize the importance of rest, and when many of these cases were treated in the out-patient departments, we did not obtain such

favorable results, can only justify the conclusion that rest was not injurious, but beneficial, and we cannot disregard, as untrustworthy, the observation that the patients who were most careful in following the advice as to complete rest showed the best results.

Among the disadvantages of rest which have been urged, are the disturbances of appetite and the constipation, as well as the unfavorable effects upon the mind which enforced immobility induces. It may be possible that some patients eat less when they are resting in bed than when they are active, but much more frequently, in my experience, the opposite is the case, as may be observed in patients free from fever who are undergoing one of the "fattening" cures, and as is often seen in tuberculous patients who experience slight elevations of temperature after exercise. The occurrence of constipation is not so important, as it may be counteracted by proper diet and by mechanical means. As much as I am in favor of keeping up the patient's spirits, I think that the injury of certain influences upon the mind has been exaggerated. The marked improvement which is observed in the first weeks of a sojourn at a sanatorium, when the psychical depression is certainly most pronounced, demonstrates beyond doubt that the chief factor in the keeping up of the patient's psychical well-being is his physical condition.

Finally we may mention another argument against too much rest, which has been often brought forward and at first glance seems very plausible. The patients who must return to their ordinary physical work after the completion of the time of treatment, should not be spoiled by too great coddling, but should be prepared for their vocation by training. This of course, applies chiefly to the inmates of the state sanatoria. It must be mentioned at once, however, that a great proportion of workingmen lead a sedentary life, for among 3656 tuberculous patients treated by the Government Insurance of the Free Cities of Germany, at least one-third had sedentary occupations, so that bodily exercise was not necessary for these according to the principle just stated. But even for those who must return to arduous physical labor, it is far better to take advantage of the rest-cure during the only too brief period at their command. It is to be expected, to say the least, that the process of connective-tissue formation which secures the healing of the pulmonary lesions can go on more perfectly and rapidly when the patient is at rest than under conditions which are less different from those under which the disease had developed.

All these considerations lead to the conclusion that in doubtful cases too much rest is less injurious than too much exercise. According to

this principle it may be regarded as unquestionably rational to establish a rule that all patients who show a rectal temperature reaching or exceeding 38.0° C. at any time of the day, should be treated in bed. The combination of rest in bed with open-air treatment is very desirable, and in these cases the transportation of the patient's bed to a verandah or balcony will be found more useful than the mere opening of windows. I have, therefore, for a long time advocated the building of balconies adjoining the bedrooms of phthisical patients.¹ DETTWEILER² and BESOLD³ also favor this arrangement, but it is not commonly accepted. Thus, for example, the Central Committee for the Establishment of Sanatoria recently made the building of only one balcony for each story a condition for a contribution towards a free sanatorium. And yet, even in free sanatoria, bed-treatment in the open air often becomes a necessity by reason of fever and hemoptysis. The rest in bed must be absolute, not to be interrupted for washing, eating, etc., but "as in a case of typhoid." It must be continued for many weeks if normal temperature does not return. In exceptional cases by persevering in this treatment one can obtain the disappearance of long continued fever and thereby a chance for lasting improvement from a sojourn at a sanatorium.

Curable patients should avoid all unnecessary movements for two months after all acute onsets or exacerbations of the tuberculous process, such as prolonged fever, hemoptysis, exudative pleurisy, and extension of the local physical signs, even when the disease seems to have become stationary. After very slight initial symptoms and a short febrile period the time of rest may be somewhat shorter, but it must be prolonged the longer and more severe is the febrile period, or the more marked are the other symptoms. Under the term unnecessary movements, I understand in the sanatorium treatment or the substituted home-treatment of these cases, all climbing of stairs except such as is absolutely needful for the open air cure, in view of the absence of an elevator; all games associated with motion, such as billiards, etc., and all sports, as well as all walking with the exception of very slow promenading.

Especial caution must be exercised in the transportation of the patient from his dwelling to the sanatorium, which takes place as a rule soon after the subsidence of an acute exacerbation. Many sins are committed in this direction, and many patients who arrive in a febrile state at the sanatorium can attribute their change for the worse, which sometimes

1 Handbuch der Therapie, Penzoldt-Stintzing, 3rd ed. III, p. 373.

2 DETTWEILER: *Loco citato*, p. 185.

3 BESOLD: *Die Anstaltsbehandlung der Tuberkulose*, Berlin, Reimer, 1902, p. 55.

leads to incurability, to the lack of proper directions or to carelessness in following directions as regards the trip to the institution. As a rule, mistakes are made even before the trip is entered upon, for the patient has to attend to various business matters, and to prepare for the journey. Walking and driving about in the city and packing should be strictly forbidden, and on the trip the patient should be treated as one who is gravely ill. Above all, there should be someone who accompanies him. The patient should be driven to the station, should only walk from the carriage to the waiting-room and thence to the train; should not lift or carry any parcels or handbags, and if it is necessary to pass the night somewhere on the way, he should be provided with a good warm room, and in general he should be spared every movement, every exposure to cold and every excitement.

In addition to these general rules concerning rest, there should be formulated special regulations for every case, and for every stage of the disease. Barring the patient's general appearance, which gives a clue to his condition only to the experienced, and even to the latter in but certain cases, the signs whereby the patient's state may be gauged are the pulse, the respiration, and the temperature.

The behavior of the pulse before and after exercise has not given me nor my pupils¹ nor other authors, for instance Schneider² any useful indications as to the amount of exercise to be allowed, although often there was a considerable, abnormal increase in the frequency of the beats after moderate exercise. Yet, at times this increase was absent or slight in the same patients. It seems to me that the frequency of the pulse-beats becomes equalized very quickly after exercise, and I think that it would be well to institute some further experiments in which the pulse is observed during the exercise. Possibly by this means we may obtain more constant differences.

The measurement of the frequency of the respirations after exercise has not been to my knowledge applied sufficiently for the determination of the amount of exercise to be allowed, and yet it is not improbable that it would give useful results. Naturally, the observation of the breathing must be conducted without the patient's knowledge, as the frequency of the respiration depends so much on the mental state and voluntary control. For example, it might be possible to count the respirations while apparently counting the pulse.

¹ PENZOLDT and BIRGELEN *Münchener med. Wochenschr.* 1899, 15-17.

² Dissertation, Breslau, 1901.

For the present, the measurement of the temperature gives the safest basis for the estimation of the amount of exercise indicated. But even here we do not find unanimity in all respects. The very place of insertion of the thermometer is a matter of different opinions. While in private practice the axilla is still often used and in the hospitals almost exclusively the rectum, the sanatoria as a rule employ the mouth. This last named method has been so generally adopted that in many articles one does not find mentioned which place of insertion was used. It must be admitted as Turban, Besold and others have shown that the insertion of the thermometer in the mouth, when carefully executed, can give very uniform results. Yet the measurements instituted by SCHNEIDER¹ which were especially made for purposes of comparison, and therefore fall under the heading "carefully executed," showed that there was an average difference of 0.25 degree C. between mouth and rectum, but that often differences of 0.4, occasionally of 0.5 or 0.6 degrees C. and even (Schroeder and Brühl) of 0.9 do occur. Such differences are really great enough to cause an uncertainty when it comes to determining the exact amount of exercise indicated for the case, with the temperature as a basis. How much more is this so when the care needed in making the observations by mouth is omitted in the routine of daily measurements. The internal temperature of the body, and this is the temperature we are concerned with, and not that of the periphery, can be measured most safely and quickly by deep rectal insertion. This incontrovertible axiom I am not called upon to prove. The disadvantages of the troublesomeness, the difficulty of supervising and the indecency of this method, especially in patients taking the rest cure in sanatoria, cannot be absolutely denied. They may be overcome, however. In bedridden patients who are confined to their rooms there is no difficulty in taking the rectal temperature. But even in the walking patients the temperature can be taken by the rectum four times daily, i. e., on awakening, before lunch, before dinner, and before retiring to sleep. The supervision of these measures is more difficult for the physicians and attendants, but in view of the greater safety and the great significance of the temperature for the diagnosis, prognosis, and treatment of the disease, all such considerations should be cast aside. I should therefore address the request to all sanatorium physicians, to introduce rectal measurements instead of taking the temperature by mouth, although I do not give myself to illusions as to their compliance with my wish.

That bodily exercise, such as for example a brisk walk of an hour's duration, raises the rectal temperature of a phthisical patient more

¹ *Loco citato*, pp. 58, 59.

markedly than that of a healthy person (often to 38 degrees C. and over) has been proved by my own investigations and by those of my pupils, and is not refuted even if SCHROEDER and BRÜHL¹ allege that our figures show smaller average differences between the temperatures of patients on leaving and on arriving as compared to healthy persons. This is due to the fact that in our patients the temperature was higher than average at the time of leaving for their walk, because they had to walk to the institute to have their temperatures taken, or for other reasons. The average temperature at departure was 36.99 degrees C. in healthy persons and 37.36 degrees in tuberculous persons. The factor to be considered in each individual case is of course not the average measurement, but the extreme of rise. Our results in this respect have been confirmed by those of TURBAN², CHUQUET and DAREMBERG³, and OTT⁴. The opposite conclusion reached by Schneider and by Schroeder and Brühl is attributable to the fact that their methods differed from ours. Schneider⁵ used the mouth temperatures, as appears from his discussion, although he does not say so specifically in his description of the method used. Schroeder and Brühl⁶ kept the patients in a moderately warm room for ten minutes before the temperature was taken. We have proved, however, that the temperature declined considerably twenty minutes after the arrival of the patients and that therefore an immediate measurement was necessary, and it may be easily comprehended that these differences in method can give considerable differences in results. The conclusions of the authors just named should not be therefore regarded as non-confirmatory of our findings.

In the same way we must reject as unproved the hypothesis of Schroeder and Brühl, to the effect that the rise in the rectal temperature is caused by a local hyperthermia, brought about by the concentration of heat in the lower part of the body. Such local hyperthermias may be caused by inflammatory processes, but so far as I know, no other cause for the occurrence of a local increase of heat has as yet been found in the human body. Even if this were so, it would alter nothing in the significance of the rise in rectal temperature, but when the authors named conclude from such an unproved hypothesis that the mouth temperature is to be preferred to the rectal, then the juggling with hypotheses loses its harmlessness.

1 *Münchener med. Wochenschr.* 1902, No. 33, 34.

2 *Beiträge zur Kenntniss der Lungentuberkulose*, Wiesbaden, 1899, S. 23.

3 Fifth French Congress for Internal Medicine, 1899.

4 *Münchener med. Wochenschr.*, 1901, No. 50.

5 *Loco citato*.

6 *Loco citato*.

Finally, I may say that I do not regard as conclusive the experimental attempts to determine by the examination of the urine for albumoses, whether the rise in temperature following exercise should be regarded as fever. As Schroeder and Brühl themselves state, there are cases reported by Krehl and Matthes, in which real fever is not accompanied by the elimination of albumose. Hence the negative result of these examinations is not to be made use of, but possibly rather the positive which Ott frequently obtained. But, after all, it is not so much the question as to whether these elevations of temperature after exercise should be termed "fever" or not. That they are undesirable in tuberculous patients everyone agrees, for experience teaches that a continued fever may result from these often repeated elevations.

From all that has been said, I consider it a part of careful treatment in tuberculosis to measure the temperature by rectum immediately after exercise in all patients who show no fever when they are first allowed walks of from a quarter of an hour to half an hour, according to their condition. Temperatures from 37.8° C. and 37.9° C. must be regarded with suspicion, while 38.0° C. and over shows that the exercise taken has been too severe for the patient. Temperatures of 37.8° C. or thereabouts are often found in the physician's office, i. e., after slight exertion, even in patients in whom the suspicion of tuberculosis does not exist.

If the limit of normal rise of rectal temperature after slight exertion be thus fixed, then this limit at complete rest in the evening should be 37.5° C. It is well, therefore, to allow no unnecessary movements in tuberculous patients with a temperature of 37.5° C. and over at rest, and to allow exceptions to this rule only when there is a considerable improvement in the general condition and in the local signs, and when no further rise of temperature is observed after exercise that is begun with due caution.

TUBERCULOUS GROWTHS OF THE LARYNX*

BY DR. LUDWIG NEUFELD.

The occurrence of tuberculosis in the form of a tumor is one of the rarer and but lately known manifestations of pathology. The so-called tuberculomata of the nasal septum which were first described by Thornwaldt are the most frequent of these forms.

The occurrence of tuberculous tumors of the skin, especially in the region of the anus, has been frequently observed (Spitzer), and similar growths have been known to occur in the clitoris (Karaian) and on the tongue (Spitzer).

The first tuberculous tumor of the larynx was described in 1877 by Ariza, and since then about forty cases of tuberculous tumors of the larynx have been published. These growths, therefore, constitute one of the rarer forms of disease of the larynx, as Gerhardt emphasizes in Nothnagel's Hand-book. They are not distinguished by any histologic change from other tuberculous lesions.

Tuberculous growths can develop primarily in the larynx, but generally they are secondary to tuberculosis of the lungs, although even in these cases they constitute an early form of tuberculosis of the larynx. They may occur in a variety of regions of the larynx, but the vocal cords are the rarest sites of these growths. They are described sometimes as polypoid, sometimes as solid tumors, sessile, with broad bases. Their size, especially that of the last-named form, appears to vary greatly. Gussenbauer and Lermoyez reported the occurrence of tumors of the larynx which were so large as to cause symptoms of suffocation. The majority of the tumors described, however, do not exceed the size of a pea. They are distinguished from granulations which frequently develop on the edge of tuberculous ulcerations by the fact that the latter scarcely ever present the appearance of new growths. These tumors are, as a rule, soft in consistence, but they may also be so firm that they are mistaken for hard cancers, even on the autopsy table (Gussenbauer). They are of a pale-red color and not infrequently show white discolorations in places. As a rule, the reaction in the surrounding tissues is absent or only slight, but of course ulcerations and tuberculous infiltrations may occur at any time in the neighborhood of the tumor. The surface of the tumor is

*From the Medical Clinic of the University of Berlin; Director, Geh. Prof. Senator. Translated for the *Journal of Tuberculosis* from the *Berliner klin. Wochenschrift*, Jan. 5, 1903.

slightly nodular, but it is always covered with mucous membrane. The tumors as a rule grow very slowly, and as these tuberculous growths can constitute an early form of tuberculosis, they may remain the only symptom of this disease for a considerable time.

From what has been said, we must conclude that these tumors have but few characteristic features. Indeed, laryngoscopic examination alone almost never was found sufficient for a diagnosis. Naturally, the most difficult cases to distinguish were those of primary tuberculosis of the larynx. The principal conditions from which these tumors are to be distinguished are syphilitic and malignant new growths. If syphilis is suspected, a test-treatment with potassium iodide will not infrequently give a clue to the nature of the process. If this remedy fails, or if there is no ground for suspecting syphilis, it is best to remove a small portion of the tumor for microscopic examination. In almost all cases in which a pronounced tuberculosis of the lungs does not point to the diagnosis, the microscope alone enables one to determine the tuberculous nature of the tumor, but even the microscopic diagnosis can lead to errors when the portion of the tumor excised does not happen to show any typical places. In the case published by Guessenbauer, the diagnosis of cancer was made after examining the bit of tumor removed by excision, and only the examination of the entire tumor obtained at autopsy showed that the growth was a tuberculous one.

For these reasons it will be of interest to consider the following two cases which were observed in the Medical Clinic of the University (Department of Diseases of the Throat and Nose; Dr. Mosse), all the more, because they belong to the rarer types of their kind. In one of these cases we had to deal probably with a primary tuberculosis of the larynx; in the other case the tumor appeared upon the vocal cord in a patient suffering from tuberculosis of the lungs.

Case 1. Ernest B., aged 52 years; a coal truckman. The family history is negative. He has had a rash over the neck, face and chest as a youth, and has been treated elsewhere by means of potassium iodide. For the past six weeks the patient has been complaining of hoarseness and difficulty in swallowing; not only in swallowing saliva, but also particularly in eating. The patient locates his pain in the region of the left side of the neck which corresponds to the upper cornu of the thyroid cartilage. He states that he cannot sleep on the left side on account of pains which are made worse by lying on the pillow with that side of the neck. He believes that he has lost flesh lately. There is a slight tendency to cough; no fever; no expectoration, and no night-sweats.

Condition, end of January, 1902: A man of moderate size, fairly well nourished. The skin of the chest can be raised up in folds. The chest is flat; the supraclavicular spaces are somewhat sunken. The percussion-note over the lungs is loud and the

breathing is vesicular. The limits of the lungs are normal; the cardiac tones are clear; the heart limits normal. The abdominal organs are negative. The urine is free from sugar and albumen. No swollen glands were found anywhere, not even in the neck. The left cervical region, at the level of the thyroid cartilage, was moderately tender on pressure. The mouth and pharynx were negative. On laryngoscopic examination the vocal cords were found slightly reddened. The false cords and the sinus of Morgagni showed nothing in particular. A tumor of the size of a pea arose from the posterior wall of the larynx in the region of the left arytenoid cartilage, sessile, with a broad base upon the posterior wall, shaped like a truncated pyramid, projecting with its apex into the lumen of the larynx. The posterior part of the left vocal cord is covered by the tumor and is pressed downward. On phonating the tumor also covers the posterior portion of the right vocal cord. The tumor is slightly nodulated on its surface but is covered everywhere with mucous membrane. Its base is pale-red, its apex whitish, and on probing it appears to be quite soft.

As the history seemed to point to a certain extent to syphilis, potassium iodide was first tried, with a negative result, for the tumor did not change in the space of six weeks. A portion of the tumor was removed for microscopic examination on March 24th, the presence of a malign new growth being suspected. The microscopic examination, which was confirmed by an authority (Dr. Oestreich), showed the presence of tuberculosis (quite numerous tubercles with cheesy centres, and giant cells).

On April 21, the tumor was removed as completely as possible by means of cutting forceps under cocaine anaesthesia. After the tumor was removed, it was found that the posterior portion of the left vocal cord had not been involved. The wound caused by the operation closed, with the exception of a small gap, after nine weeks observation, and the symptoms disappeared. The examination of the removed tumor again showed the presence of tuberculosis. The patient was discharged cured after three months.

Case 11. Joseph H., 51 years old; officer. He had influenza in March 1901, and since then coughed and expectorated. For some time he has had frequency of urination and increased thirst. His family history was negative. He has lost some flesh lately. A polyp of the vocal cords was found in this patient some time ago in one of the local dispensaries.

Condition, end of August, 1901: A man of moderate size; fairly well nourished. The skin of the chest can be raised in folds. Dullness over both apices. On auscultation, bronchial breathing and fine moist râles. The heart and abdomen showed nothing unusual. Six per cent. of sugar was found in the urine; no albumen.

On examination, the vocal cords were found slightly thickened and somewhat reddened. The false cords were not altered. The posterior wall was somewhat thickened. A polyp of the size of a pin head was found at the junction of the interior and middle thirds of the right vocal cord. This polyp was pedunculated and entered into the chink of the glottis in phonation. Although the tuberculous nature of this growth was suspected, no attempt was made to remove it on account of the high percentage of sugar found in the urine.

About two months later a typical tuberculous ulceration developed in front of the polyp and reached to the anterior commissure. In the course of four weeks the left vocal cord became ulcerated. The polyp was now found at the posterior end of the ulcer and floated at each respiration. In the meanwhile, the symptoms had become very much worse. There was an irritable cough which tormented him night and day.

Inasmuch as the process in the lung had not grown worse, and as the amount of sugar in the urine had diminished to one half per cent. after appropriate diet, the polyp and the ulcerated portion of the vocal cord were removed towards the end of November. After a treatment with lactic acid for six weeks, thick scars formed at the site of the removed tissues. The patient's symptoms were almost entirely relieved. The examination of the polyp gave almost the same results as in the first case.

The size and the situation of the growth in the cases just described seemed to justify the performance of an intralaryngeal operation. It may be noted, however, that opinions differ as to the treatment of tuberculous tumors of the larynx. Dehio reports a case of primary tuberculous tumor of the larynx which was removed after laryngotomy. The patient died a short time after the operation, and the course of the disease induced Dehio to believe that some infectious tuberculous material had been aspirated from the ulcerated wound into the lungs, and that thus arose a large number of scattered minute tuberculous pulmonary foci. For this reason Dehio advises against the operative treatment of tuberculous tumors of the larynx and recommends their destruction by the galvanocautery. Panzer replied to this somewhat pessimistic idea of Dehio that it is doubtful whether in this case the first sign of a general infection of the organism with tuberculosis was the tumor in the larynx which at that time could not even be demonstrated on laryngoscopic examination. As a matter of fact, a case reported by Grünwaldt, shows that even extensive tuberculous tumors can be cured by laryngofissure. In the same way, the publications of Schäffer, Avellis, Clark and Trautmann show that permanent cures or considerable improvement can be obtained by endolaryngeal operations. One should not resort to the more severe procedure of laryngofissure unless the tumor produces symptoms of suffocation owing to its size, or unless it is impossible to remove it on account of its location.

With the exception of those cases in which a vital necessity exists for the operation on account of threatening suffocation, one should, of course, refrain from operating in cases of advanced pulmonary tuberculosis. The condition of the lungs in general should be the deciding factor in the prognosis of these cases.

Trautmann says correctly that the prognosis is bad from the start, in those cases in which changes in the lungs or other organs are associated with the laryngeal tumor. Even in those cases in which a complete cure of the throat trouble has been effected the prognosis is bad when the pulmonary disease goes on, for the patient dies in spite of the cure effected

in his larynx. Hence of the two cases which we have described here, the first is more favorable as regards prognosis.

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REVIEW OF CURRENT LITERATURE.

THE PREVALENCE OF PHTHISIS AMONGST LAUNDRESSES.

The hot steam-laden atmosphere in the washing and ironing rooms, says C. F. McCleary (*British Medical Journal*, September 13, 1902), the wetness of the washing room floor and deficient ventilation so often found in the hastily converted dwelling houses which form the majority of laundries in England, would appear to predispose the workers to phthisis, not only by lowering vitality, but by rendering the respiratory passages especially liable to catarrh. The restrictions of the factory act as to number of hours of work per day, age of employees, certificate of fitness for employment, etc., are not applied to laundries. In addition to these predisposing factors, the author directs attention to the danger of infection in the sorting room, where in every laundry a considerable quantity of handkerchiefs, pillow cases and the like which have been soiled with tuberculous expectoration and discharges, without any attempt at disinfection, must be received from time to time.

Miss Deane, one of His Majesty's Lady Inspectors of Factories, investigated this subject by searching the records of certain hospitals in London which are much frequented by sick laundresses, with a view of ascertaining the relative proportions of cases of phthisis to the total number of laundresses admitted, and the total number of women other than laundresses, respectively. Of the total number of women admitted into the Wandsworth and Clapham Union Infirmary in the years 1899 and 1900, Miss Deane found that phthisis occurred in 8.7 per cent. of the total number of laundresses as compared with a percentage of 5.3 among other women.

Dr. McCleary in investigating the subject along the same lines examined the records of this same infirmary from January, 1895, to the end of last June. The author found that during this time 795 laundresses had been admitted of whom 77 suffered from phthisis. Of women engaged in other occupations 2,476 had been in the infirmary and of these 141 had suffered from phthisis. Of unoccupied women there were 1,851 and among these 130 cases of phthisis. The percentage of phthisis among the laundresses was 9.68, among the women of other occupations 5.69, and among the unoccupied women 7.02.

The author does not claim that his statistics are sufficient for very definite conclusions, but considers them suggestive and indicative of the comparatively high degree of prevalence of phthisis among laundresses.

ON THE OCCURRENCE OF PSEUDOTUBERCULOSIS BACILLI
IN MAN.

Pseudotuberculosis is a disease which resembles more or less the true tuberculosis produced by Koch's bacillus, but which depends upon another cause, the bacillus of pseudotuberculosis.

Dr. L. Wrede (*Beiträge zur pathologischen Anatomie und zur allgemeinen Pathologie*, Vol. XXXII, No. 3, p. 526) presents a detailed study of the pseudotuberculosis bacillus as the incitor of pseudotuberculosis in man. In his introduction he emphasizes the fact that a certain confusion of terminology exists with regard to these germs. There is a group of bacilli that are resistant to acids, and that are closely related to the tubercle bacillus of Koch. These germs are termed pseudotubercle bacilli in analogy to the diphtheria and pseudodiphtheria bacilli. There is a second group of bacilli, not resistant to acids, that have nothing to do with the tubercle bacillus of Koch, but are called pseudotuberculosis bacilli because they excite pseudotuberculosis. We have, therefore, *pseudotubercle* and *pseudotuberculosis* bacilli and both can cause a pseudotuberculosis. The author reviews the literature of the cases in which the pseudotuberculosis bacillus has been found in man and cites a case which he has studied in detail. An eight-months' foetus that died thirty-six hours after birth was found on autopsy to show numerous lesions resembling submiliary tubercles in the soft palate, the tonsils, the larynx, the œsophagus, the suprarenal capsules, the colon and the liver. On microscopic examination these foci were found to show the characteristics of tuberculosis. The tubercle bacillus was not found in any of the organs but everywhere there was an entirely different bacillus which was short, thick and had rounded ends. It was from 0.5 to 1.5 μ . long, and, as a rule, occurred in pairs, two rods arranged one behind the other. Occasionally it occurred in large masses and sometimes in chains. It stained with the aniline dyes in the tissues and also with Gram's stain, but it was not resistant to acids. This bacillus was easily obtained in pure cultures from the tissues. It grew in alkaline peptone broth, in which it produced a diffuse turbidity within twenty-four hours. On the second or third day a whitish sediment collected which on shaking disintegrated into threads. It grew well at room temperature and still better in the incubator in nutrient gelatine which did not become liquified. No capsules were formed about the germ in the body nor was the bacillus motile. The size of the bacillus varied according to the nutrient medium and the rods may be long or the germ may occur as a coccus. Occasion-

ally it showed club-like swellings. The bacillus was very resistant to Gram, but not uniformly so, for some of the germs became completely decolorized, while a large number withstood treatment with alcohol for fifteen minutes. The poles of the rods retained their color longest.

Injection of pure cultures of this bacillus produced lesions in guinea pigs and mice similar to those found in the body of the child. The author concludes that this was a case of pseudotuberculosis, but that the germs which caused it differed completely from any bacillus hitherto described. A number of germs which differed more or less one from another have been described under the name of pseudotuberculosis bacilli although it has not been possible as yet to show in what relation they stood to one another. These germs must have represented either variations of one organism or the name of pseudotuberculosis bacilli has been applied to a number of germs that had nothing to do with one another.

The following groups may be arranged by comparing the properties of the various pseudotubercle bacilli described :

1. Decolorized by Gram; not liquifying gelatine: Charrin and Roger, Dor, A. Pfeiffer, Nocard and Masselin, Nocard, Zagari, Courmont, Grancher and Ledoux, Lebard, Parietti, Leroy?, Hayem, Bettencourt, Woronoff and Sineff, Mazza and Tenzi?, Delbanco, Bonome, Lustig, Courmont, Muir, Liguères and Cipollina.

2. Not decolorized by Gram; not liquifying gelatine: Preisz, Manfredi, Galli-Valerio? Hayem?, Cherry, Thomas and Bull, Turski?, Vallé?, Guinard and Morey. Eventually, Klein, Kutscher; Reed, Bongart.

3. Liquifying gelatine, decolorized by Gram: Du Cazel and Vaillard, Legrain, Vincenzi?.

It is remarkable that the groups correspond to a certain extent to the animals which were inoculated to obtain pure cultures. Group 1, was found in spontaneous pseudotuberculosis in guinea-pigs and rabbits. The cases of Kutscher, Reed and Bongart occurred in mice. In group 2 the germs were found in man, cattle, sheep and pigs. In group 3 only human material was found to contain the bacilli.

Preis (*Annales de l'Institut Pasteur*, 1894, No. 4, p. 231) gave the most complete analysis of the work done in this field. Cipollina suggested that the typical pseudotuberculosis bacilli found in rodents should be distinguished from the "atypical" forms which differ from the former by their resistance to Gram and their power of liquifying gelatine. The author does not care to express an opinion as to whether this division is justified.

He was unable to identify his bacillus with any of the germs described in literature as pseudotuberculosis bacilli. In some respects it corresponded in size and variability from cocci to bacilli to the other pseudotuberculosis bacilli. It resembled especially the illustrations of Manfredi. As regards staining it corresponded to the germs of Manfredi and Priesz, for it resisted Gram and stained well with the aniline dyes, and differed from the "typical" pseudobacillus by the lack of lacunæ in the stained bodies. In distinction from the pseudobacillus of mice, it never showed any ramifications. It gave no long chains in bouillon cultures, which are so characterized for the "typical" group. Chains were only seen in the tissues and on the serum medium. The author's bouillon cultures were distinguished from the "typical" group by crystal-formation; from those of Preisz by absence of a marked surface growth; from both by the fact that the diffusely opaque culture medium did not clear up. They resembled on the other hand, the bouillon cultures of Manfredi.

His agar and gelatine cultures were but slightly characteristic. They corresponded to the "typical" group in their resemblance to colon and typhoid cultures, but they seemed of a lighter, yellowish-brown color and more finely granular than these. No distinguishable odor was noted, although Pfeiffer's germs grown under similar conditions showed this plainly.

Vincenzi called attention, it is true, to the fact that the temperatures which Wrede used were not favorable for the development of this sign. No crystals clouded the medium, but Manfredi's and Preisz's germs gave both characteristics, crystals and odor. The author's germ is distinguished from Preisz's by the form of the colonies and their quick growth at room temperature. Wrede's bacilli grew in white colonies on potato, while the other pseudobacilli showed yellow patches on this medium. Manfredi's and Preisz's germs grew in yellow colonies on blood serum, the author's germ in white colonies on this medium. The "typical" pseudogerms did not grow well on blood serum.

These were the principal cultural differences between the author's germ and those described as pseudotuberculosis bacilli by other authors.

As regards lesions produced experimentally these germs correspond more closely to one another, although there are differences in the organs preferred and the size of the nodules.

CURRENTS OF HIGH FREQUENCY IN THE TREATMENT OF TUBERCULOSIS OF THE LUNGS.

The results of treatment with currents of high frequency in pulmonary tuberculosis have as yet found but little appreciation. Dr. H. Strebel, of Munich, in a recent article (München, Otto Gmelin, 1902)

gives the results of his observations on the effects of this method of treatment. The hopes which the inventor of these currents, d'Arsonval, placed upon this method have not all been realized, and even his own countrymen have shown that currents of high frequency have not the influence upon gout, rheumatism, obesity and diabetes, which the inventor expected. A great deal of work is still to be done in the determination of the action of currents of high frequency. The present author concludes, after an investigation of this subject, that no appreciable changes in the metabolism of the body can be obtained by means of the appliances for the generation of currents of high frequency that are to be found in the market. But this is probably the case only with small instruments with a small capacity, and it is possible that by means of large quantities of energy, such as are used by Tesla, other results can be obtained. The results recorded by those who have hitherto investigated the subject should therefore be regarded as only relative, and by no means conclusive. The apparatus which they use, a spark-inductor giving a spark of 25 centimetres, is a mere toy as compared to the giant instrument that Tesla used. The French investigators, Doumer and Oudin have used currents of high frequency in the treatment of tuberculosis by allowing the waves from a simple or double resonator to flow upon the thorax. This produces a very marked and persistent hyperæmia at the exposed places, which probably acts in the same way as local applications of heat, in other words produces a vasomotor effect similar to that which results from hydrotherapy. The author does not think that there can be any question as to a direct bactericidal effect of currents of high frequency, and believes that the applications of these currents offers a very good adjunct to the other means of treating pulmonary tuberculosis. He obtained excellent results in four cases of incipient tuberculosis by the exclusive use of currents of high frequency. Yet, it is difficult, he says, to prove that these currents have a specific effect; for spontaneous recoveries are not very rare in tuberculosis. He gives the histories of the ten cases which have been published in French by Doumer (*Action des courants de haute Fréquence et de haute Tension sur la Tuberculose pulm. chron.*, *Annales d'Électrobiologie* No. 2, 1900) and Oudin, and promises to add his own observation in a special article which is to appear shortly.

Doumer has studied the effects of currents of high frequency upon chronic tuberculosis of the lungs for four years, and has used this method in seventeen patients of both sexes. The results which he has obtained are sufficiently well marked to remove the fear that further observations will change the general conclusions which may be made from his data.

Most of the patients were in advanced stages of pulmonary tuberculosis and some already showed symptoms of dissolution. Only two were in the initial stages. The treatment was almost identical for all these patients. In some he used a current directed upon the chest at the sites corresponding to the suspected tuberculous foci, both anteriorly and posteriorly, i. e., in most cases in the hollows under the clavicle and below and above the spinous process of the scapula. This current was generated by a large Oudin's resonator which represents the most important invention in this field since the work of Tesla. In other patients the current was used from the secondary coil of the Tesla apparatus. The treatment was often repeated daily, at times only thrice a week and lasted from five to twelve minutes at each sitting. Doumor did not seek to avoid the long and bright sparks which passed between the electrode and the patient, as they are not painful. Although the general effect of this treatment differed widely on account of the varying personal elements and also on account of the advanced degree of the disease, yet some general conclusions can be drawn from the results. Under this treatment an incipient case shows an improvement in the various symptoms, but not always in the same order. Some symptoms, e. g., the night sweats and the evening fever, disappear first, while the emaciation, the cough and the expectoration, are removed much more slowly and the physical signs continue to be appreciable for long time. As a rule, no particular changes are noted after the first few applications, and in some cases, in which the respiratory organs are very sensitive, the attacks of cough become more frequent after the first few séances. After the fifth to the eighth application, the night-sweats begin to diminish, and they generally disappear after the fifteenth, never to appear again, except in case of complications due to exposure to cold. The fever also disappears at about the same time, and after the fifteenth sitting, or even before, the appetite begins to improve. At the end of a month or two, the appetite even becomes exaggerated. After the second month, or even before, the cough becomes less persistent and painful, and the patients often sleep through the whole night without waking. The number of bacilli in the sputum also diminishes. The physical signs disappear more slowly and may be present for three or four months after the beginning of the treatment. At the same time, the patients gain weight with remarkable rapidity.

THE INDUCTION OF LABOR ON ACCOUNT OF THE PRESENCE OF INTERNAL DISEASES.

Dr. Friedrich Schauta, of Vienna, (*Wiener med. Wochenschrift*, January 3-10, 1903) considers the influence of various diseases of the internal organs upon the pregnant woman and discusses the indications for an artificial interruption of pregnancy in the presence of certain severe forms of these maladies. A study of the literature of this question cannot lead to a definite conclusion, for it is only the most severe cases that are reported and in order to judge all the phases of this question, it is necessary to consider all, even the mildest cases. Only large clinics in which the material has been observed carefully and scientifically for a long period can give a basis for conclusions as regards the influence of the various diseases upon pregnancy, labor and the puerperium. The material which the author employed for the present study included 40,000 labors observed in his own clinic and recorded in literature.

In speaking of tuberculosis in connection with his subject, the author says that, in addition to the dangers which are common to pneumonia and pleurisy, consumption introduces the element of the general poisoning into the already weakened constitution of the patient. The long duration of tuberculosis and its rises of temperature must be considered as unfavorable factors in the influence of this disease upon pregnant women. The author's experience shows that pregnancy very frequently causes the relapse of a latent tuberculosis, and in many cases the onset of a first attack of tuberculosis is coincident with gestation. We may speak, therefore, of a tendency of pregnancy to re-awaken old tuberculous processes and to excite the development of new tuberculous lesions in the lungs.

Tuberculosis progresses rapidly during pregnancy, is accompanied by hemoptysis in almost 50 per cent. of the cases, and leads to the interruption of gestation in about 70 per cent. of these patients. Even in 8 per cent. of the cured cases, a premature termination of the pregnancy is noted as the result of the lesion in the lungs. In 91 per cent. of patients who develop pulmonary tuberculosis for the first time during pregnancy, gestation is interrupted. The later in pregnancy tuberculosis occurs or recurs, the more certain is the occurrence of a premature labor.

Tuberculosis of the larynx must, however, be regarded as the most serious complication of pregnancy. The author studied 18 cases of this kind in 10 of which labor occurred prematurely shortly after the appearance or relapse of the disease. The symptoms of suffocation may be

so marked in these cases that, as happened in one of our patients, tracheotomy was necessary.

As regards the obstetrical treatment of these cases, the author warns against puncturing the membranes too early as that would increase the duration of the labor. Rapid dilatation of the cervix, version, and extraction should not be attempted on account of the danger of collapse and of oedema of the lungs. In ordinary cases of tuberculosis, the mortality is greater after an artificial interruption of the pregnancy than after a normal termination. Yet, in tuberculosis of the larynx, the disease may threaten to grow worse to such an extent that the labor does not add materially to the danger. A certain benefit may be expected by artificial induction of labor in the first part of pregnancy in severe cases of tuberculosis and in the second part in mild cases, especially if the patient has rapidly grown worse during the pregnancy, or during a former pregnancy. In hopeless cases of tuberculosis, artificial labor may be induced in the interest of the child, and even in desperate cases the mother may sometimes improve temporarily after the labor. These labors should be induced by tamponage or by the introduction of a bougie, but not by means of puncturing the sac.

In miliary tuberculosis, a premature labor, death of the child, and death of the mother, occurs in almost all cases, and in view of their hopelessness it is best to save the viable child from infection as soon as possible by the induction of labor.

GANGRENE OF THE SKIN FOLLOWING SUBCUTANEOUS INFUSION.

Wormser, (*Deutsche med. Woch.* No. 41, 1902), in a consideration of this subject, refers first to the animal experiments of Baisch, which were undertaken to establish the cause of gangrene of the skin which in six cases followed subcutaneous infusion in the woman's clinic at Tübingen. Baisch's results confirmed his suspicion that the soda contained in the Tavel's solution (common salt 7.5 g., calcined soda 2.5 g., in water 1000 c. c.) used for hypodermic injection was responsible for the ill effects in these cases.

Wormser, however, has had a like experience in a case in which Tavel's solution was not used; but in which instead physiological salt solution, which Baisch pronounced harmless, was employed. Again, while the author was assistant in the clinic of Kocher and Müller at Bern he witnessed a large number of infusions (more than 100) which were made with Tavel's solution. In one instance gangrene followed as des-

cribed by Baisch, but this was in a decrepit individual with an extensive actinomycosis of the abdominal wall and veriform appendix. The infusion followed laparotomy and was made into the subcutaneous tissue of the thigh. Soon thereafter extensive gangrene occurred which progressed until the large vessels of Scarpa's triangle were exposed. The patient died of marasmus of the most severe type, which was at the time attributed to the gangrene.

On the other hand, in 1899, in the woman's clinic at Basel, Wormser observed a second case in which Tavel's solution was not used. In this instance the infusion was made because of the appearance of signs of acute anaemia following post partem hæmorrhage. Four hundred c. c. of 0.7 per cent. sterile sodium chloride solution were injected subcutaneously in the anterior surface of the right thigh. A few hours later a bloody suffusion appeared about the point of injection; the next day this area became paler, cool and insensitive and gradually a deeply extending dry gangrene developed, the necrosis progressing to the fascia lata. Here was a case in which gangrene followed the use of common salt solution.

In the literature Wormser has been able to find only one other case of gangrene after infusion in which the physiological (0.6 per cent) common salt solution was employed. This case, reported by Ostermann, is of especial interest, because the injection was made into the breast as well as the thigh and the gangrene developed only in the thigh.

Baisch's evidence for his conclusions is partially of a clinical and partially of an experimental nature. His clinical evidence consists in the fact that in the woman's clinic in Tübingen not another case of gangrene has occurred since Tavel's solution was abandoned in favor of the common salt solution. While the author admits this fact, he points to his own experience in which, on the one hand, gangrene occurred in only one case of over a hundred infusions of Tavel's solution and, on the other, also once in a comparatively small series of infusions with common salt solution.

While the results of the animal experiments have more weight, to Wormser they do not appear to furnish any proof for man, because the large amount of soda which Baisch used to produce gangrene in his animals (for an 1800 g. rabbit, 200 c. c. of a solution containing 2.5 parts of soda in 1000 parts of water was necessary to cause gangrene with certainty) is far in excess of the corresponding amount for respective body weight contained in the Tavel's solution as employed clinically in man.

Furthermore, Wormser is of the opinion that the long period which intervened in some of Baisch's cases between the injection and the occur-

rence of the gangrene would seem to argue against the latter's conclusions. If in a given case this period is from ten to thirty-nine days, the gangrene is not readily attributable to the toxic action of the soda on the tissues. Zimmerman, who in his dissertation considers the same six cases of cutaneous gangrene which in the Tübingen clinic followed the use of common salt infusions, suggests that the effect of common salt upon the vessel nerves might be a consecutive disturbance in the nutrition of the vessel which might gradually after a longer time lead to gangrene. Wormser has also entertained the idea that trophic nervous disturbances might play a rôle in the occurrence of such gangrene. But these are but speculations which are not easily proven, and the explanation is still lacking, since that offered by Baisch is certainly not sufficient for the common salt cases, nor for his own cases of long "incubation" period. Wormser concludes that while the explanation of Baisch may perhaps apply in some instances it is still not generally a valid one.

THE THERAPEUTIC VALUE OF CANTHARIDINE.

Professor Liebreich contributes a short article on this subject to the *British Medical Journal*, Oct. 18, 1902, in which he calls attention to his own use of the remedy since 1891. He says that the tincture of cantharides, even if prepared with the greatest care, is most uncertain in composition, because the active principle of cantharides varies between 0.3 per cent. and 0.6 per cent; consequently some tinctures would possess double the strength of others.

After Robiquet succeeded in isolating the crystalline active principle, called cantharidine the employment of cantharides as a therapeutic agent could be considered anew. Unfortunately this substance is insoluble in water, but its compound with an alkali is soluble and has been used by Liebreich for subcutaneous injections. Inasmuch, however, as the drug must be administered in some instances for a long period, he abandoned its subcutaneous use for the internal administration of the soluble alkaline compound, exhibiting it in the tincture of orange peel, 0.2 parts of cantharidine to 1000 parts of the tincture. One cubic centimeter of the liquid contains 2 decimilligrammes of cantharidin. As a rule, 0.5 c. c. of this liquid is a sufficient dose and Liebreich has never exceeded 0.75 c. c. at a single dose. It is best given in a small quantity of water.

If the doses are kept within these limits no toxic action is noted; nevertheless it is well to determine the proper dose for the individual patient. The presence of albumen in the urine should be excluded before

proceeding to the employment of the drug. If albumin appears during its administration, or if the patient suffers pain, the author recommends the addition of a few drops of tincture of opium and reduction of the dose.

The action of cantharidine is on the capillaries and while all are irritable they are not so in like degree, the most irritable being those of the kidneys. By its effect upon all the capillaries the drug facilitates the passage of nutrient fluids to the cells. This action is more particularly marked upon capillaries which have already undergone pathologic changes, a theory which is strongly confirmed in the treatment of lupus vulgaris by the occurrence of temporary redness and swelling and by the transudation of serum from open wounds. The treatment which may, therefore, be considered a nutrient one, has in many instances led to a complete cure.

Liebreich has also observed the utility of cantharidine in other directions. As the remedy favors the passage of nutrient fluids through the capillaries it likewise facilitates the passage of drugs. Thus, a number of cases of severe syphilis which have been treated with inunctions of mercury without effect, were entirely cured when this treatment was combined with the administration of cantharidine, and in the same manner success was attained in the treatment of certain skin diseases.

In conclusion the author again calls attention to the necessity of individual dosage, and says that while in some patients albuminuria is induced by the two-hundredth part of one milligramme, others tolerate easily a dose seven times as large.

[The Editor can testify to the action of cantharidine upon lupus and upon other visible tuberculous processes, especially of the larynx, and has witnessed the stimulating effect referred to by the author and which in several instances led to cicatrization and cure. The great painfulness of the hypodermic injections then employed and in one patient the occurrence of an aseptic necrosis, at the seat of injection, of an area of tissue as large as an egg, led to its abandonment. Should, however, its internal use secure the physiologic and therapeutic effect as satisfactorily as the author indicates, cantharidine may yet become a valuable aid in the treatment of tuberculosis, especially of lupus, and of tuberculous laryngitis. The necessity of watching the kidneys during its administration should not militate against its employment.]

THE EFFECT OF CLIMATE ON LARYNGEAL TUBERCULOSIS
WITH SPECIAL REFERENCE TO HIGH ALTITUDES.

Dr. Robert Levy of Denver (*New York Med. Journal*, Nov. 1, 1902) in presenting an analysis of 205 cases of tuberculosis of the larynx says: "My purpose was not to laud Colorado as a Mecca for laryngeal tuberculosis, nor did a preconceived optimism prejudice my conclusions. In fact, I did not know when beginning this paper where the analysis would land me." While altitude is comparatively of little importance in the treatment of tuberculosis of the upper air passages, other climatic influences, such as temperature, sunshine, humidity, dryness, pure air, dust-laden air, etc., need to be taken into account.

The classification of the 205 cases best suited for the purposes of the author's report, shows that, in certain cases, pulmonary and laryngeal tuberculosis develop in climates widely different before the patients resort to Colorado; in others both lung and throat lesions developed in Colorado or in similar regions; and in others throat lesions, developed in Colorado or similar climates while the pulmonary trouble began elsewhere. Again certain cases presented no determinable lung affection whatever, being primary laryngeal cases, and of these, very few in number, one originated in Colorado.

Of cases having both lung and throat lesions, 11 originated in Colorado or allied climates, and 152 elsewhere; number in which lung lesion originated elsewhere, throat lesion in Colorado, 37. Of cases having only throat lesions 1 originated in Colorado, and 4 elsewhere. Total 205.

Fully 30 per cent. of all cases of pulmonary tuberculosis sooner or later show signs of laryngeal involvement, but Dr. Levy is not aware that anyone has ever attempted to determine when in the course of the disease this occurs, not what may be the effect of climate upon its development.

The author next tabulates the average duration of lung lesions in the various classes of cases above indicated, as well as average length of residence in Colorado, and shows:

1. That in cases in which both lung and throat lesions develop in Colorado the throat lesion manifests itself 48 weeks later than in those originating elsewhere.
2. That in cases in which lung lesions develop elsewhere and throat lesion in Colorado, the throat lesion manifests itself 62.3 weeks later than those originating elsewhere.

Levy concludes: "It would, therefore, seem that, so far as the devel-

opment of laryngeal tuberculosis is concerned, the effect of high altitude is to retard it by more than a year, notwithstanding the natural tendency for the occurrence of this very common complication of pulmonary tuberculosis."

[Someone has said that there is nothing more unreliable than statistics, and while the author, as he expressly states, has not permitted prejudice to influence him in his conclusions, the figures which he presents in his analysis of cases may possibly be somewhat misleading.

It is a fact which Dr. Levy may have failed to appreciate that truly early tuberculous infiltrations in the larynx often exist without disclosing their presence by any symptoms of which the patient himself is conscious. Neither, as most laryngologists agree, are such conditions always easy of recognition by means of the laryngoscope. In fact the cases are not so few in which it is quite impossible, even for an expert, to determine positively the existence or non-existence of an incipient tuberculous process in the larynx by any means except the tuberculin test, unless portions of tissue be removed for histological diagnosis which in the early stages of the disease is not justifiable.

Granting the absolute exclusion of laryngeal involvement, at the time of their arrival in Colorado, in the cases which the author says developed laryngeal lesions thereafter, it would still seem evident that the date of the beginning of the laryngeal affections in patients in whom this developed before resorting to Colorado, could only have been approximately determined by the date to which the patient referred as the onset of subjective symptoms.

Inasmuch as it is the exception and not the rule that the general practitioner is at all proficient in the art of laryngoscopy, therefore, unless these patients were all referred to Colorado by expert laryngologists who not only were able to determine the very first evidence of the laryngeal disease from a laryngoscopic standpoint, but also noted the exact date of its appearance, it would seem remarkable that Dr. Levy has been able to calculate to such a nicety the beginning of the laryngeal involvement in patients, who, until their arrival in Colorado, manifestly could not have been under his personal observation. Furthermore it is to be remarked

that the histological formation of the individual tubercle is a microscopical process even the approximate date of initiation of which in the living subject no man can say. It would be quite as reasonable to assume the observation of the entrance into the organism of the specific germ.

Neither is the assumption of a primary laryngeal tuberculosis tenable merely because no signs of pulmonary disease can be detected by means of physical examination. The primary localization of a tuberculous affection can with certainty, and then with no little difficulty, be determined only by a most critical macroscopic and microscopic examination, post mortem, of all organs and tissues. The percentage of cases of primary involvement of the larynx which Dr. Levy records (5 cases in 205, or 2.43 per cent.) impresses us as extremely high and it is exceedingly probable that could these cases be submitted to investigation from the standpoint of the pathologist the result would be an entirely different showing.

Truly it does not seem to us that Dr. Levy has proven his point. On the contrary, without entering into consideration of the recognized influences of climate in tuberculosis, it would appear that the evidence which he adduces for his conclusions, indicates rather a too hasty judgment, than any actual effect of high altitudes upon the course of laryngeal tuberculosis.—ED.]

TENT LIFE IN THE TREATMENT OF TUBERCULOSIS.

This is the subject of a paper read by Dr. Holmes of Denver before the recent meeting of the Mississippi Valley Medical Association at Kansas City.

For the past five years the author has been making observations with a view of determining the practicability of tent life in the treatment of tuberculosis. It is in the rural mountainous districts and by keeping the patients in tents during all seasons of the year, with the enforcement of a systematic regimen, that the best results have been obtained. Tent architecture is one of the chief factors upon which the success of tent life depends, and while the ordinary wall tent, which is the simplest form in use, has undergone many improvements, the Munson Sanitary Tent, recently adopted by the United States army, is probably the best tent yet devised.

Still no tent has been found which gives entire satisfaction during all seasons of the year. After many attempts to overcome various objections, Dr. Holmes has succeeded in combining the advantages of a tent and those of a cottage in what is known as a Sanitary Tent-Cottage, the principles of construction of which he gives in detail. With double walls, and an overhead fly, a wooden floor, and with eave and roof ventilation, windows and a mechanism for converting it into a tent pavilion, of simple structure rendering it easily portable, the tent-cottage costs approximately sixty dollars. In cold weather the tent is heated.

Dr. Holmes summarizes the results of tent life studied clinically as follows: Appetite increases, nutrition improves, cough disappears, night-sweats cease, sleep improves, weight increases, temperature falls, tendency to "take cold" diminishes, respiration improves and the pulse rate diminishes. Marked improvement has been observed in all stages of the disease as a result of tent life, but early cases and those well advanced in convalescence offer the best results.

[While there is no objection to tent life in the treatment of tuberculosis providing the patient is properly protected from exposure, equally good results are constantly being obtained in at all favorable cases by other means as well. It is to the influence of sunlight that the chief benefits of climatic or open air treatment are generally attributed and this influence is to be secured in equal degree in any climate, inasmuch as the sun does not shine at night, whether the patient sleeps in a tent or in a well ventilated apartment. The advantage which appeals to us in the employment of tents, especially for public institutions, is their great cheapness of construction as compared with that of suitable buildings, whereby accommodations for a much greater number of persons may be afforded at a given cost. The tent-cottage devised by Dr. Holmes seems admirably adapted to its purposes and combines various facilities for the comfort of the occupant, which is by no means an unimportant feature.—Ed.]

PRESENCE OF TETANUS IN COMMERCIAL GELATIN.

Dr. John F. Anderson, *Hygienic Laboratory Bulletin*, No. 9, Sept., 1902, reports the results of investigations made in the laboratory of the

United States Public Health and Marine-Hospital Service, relative to the presence of tetanus in commercial gelatin.

The author cites a number of cases from the literature in which tetanus followed the subcutaneous injection of solutions of gelatin for hæmostatic purposes. In one of these cases, reported by Hochhalt and Herezel, in which tetanus followed an injection of 2 per cent. gelatin after splenectomy, Dr. Laszlo Deutsch studied bacteriologically the gelatin used, finding an anaerobic spore-bearing bacillus which grew after the gelatin had been boiled for five minutes. Deutsch advised that gelatin which is to be used as a hæmostatic be inoculated with *bacillus subtilis* before sterilization, because, as this organism is more resistant to heat than that of tetanus, if there is no growth of *subtilis* the gelatin can be used without fear of tetanus.

Of seven samples of gelatin examined by Anderson one contained tetanus spores and it was found that .000022 c. c. of a bouillon culture from this specimen sufficed to kill a mouse, with typical symptoms of tetanus, in four days, the period of incubation being thirty-six hours.

Two samples showed an oval end spore whose identity was not proved, but which in stained specimens would be hard to distinguish from tetanus.

The thermal death point of the organism isolated was found to be between twenty and thirty seconds at 100°C.

From his investigations Dr. Anderson concludes that gelatin to be used for injections should be boiled at least ten minutes on account of the variability of the thermal death point in different species of tetanus, and suggests that when, as in hospitals, there is likelihood of gelatin injections being used for hæmostatic purposes the gelatin solution be sterilized by the fractional method on three successive days, and kept ready for use in sterile containers.

PERFORATION OF THE ŒSOPHAGUS BY TUBERCULOUS GLANDS.

Riviere (*British Medical Journal*, Jan. 24, 1903) reports three cases which occurred at the East London Children's Hospital, the necropsy in each case being performed by himself. The glands situated below the bifurcation of the trachea were the cause of the trouble and, as one would naturally expect, there was associated in each case considerable abdominal involvement. Tuberculous ulcers of the stomach were found in one case, constituting a very rare condition. Intestinal ulceration

and caseous mesenteric glands were present in all three cases, while in two, the retroperitoneal glands were also caseous, a condition which, in the author's experience, is by no means common. In two cases, the gland had completely emptied its caseous contents.

In children the gland at the bifurcation is often the first visible seat of tubercle in the body, and one may suppose that in some cases, the disease goes no further. Riviere is inclined to think that this may be the cause of many cases of oesophageal diverticulum and in conclusion says, that beyond the causation of far-spreading abdominal tuberculosis, perforation of the œsophagus by a caseous gland seems to give rise to no symptoms and its presence cannot be diagnosed during life.

BOOK REVIEWS.

BEITRÄGE ZUR KLINIK DER TUBERKULOSE. Unter Mitwirkung der Herren Prof. Dr. Bettmann, Hofrath Prof. Dr. Fleiner, Doc. Dr. Gaupp, Doc. Dr. Hammer, Doc. Dr. Hegener, Prof. Dr. V. Hippel, Doc. Dr. Jacoby, Prof. Dr. Jordan, Prof. Dr. Jurasz, Doc. Dr. Nehr Korn, Prof. Dr. Petersen, Prof. Dr. Schottländer, Doc. Dr. Schwalbe, Doc. Dr. Simon, Doc. Dr. Sætbeer, Doc. Dr. Starck, Doc. Dr. Volker, Prof. Dr. Vulpius. Herausgegeben von Dr. Ludolph Brauer, a. o., Professor an der Universität Heidelberg. Heft 1: Brauer, Prof. Dr. L., *Das Auftreten der Tuberkulose in Cigarrenfabriken*, Mit 6 Tafeln. Hoffmann, Dr. W., *Beitrag zur Kenntniss der Tuberkuloseverbreitung in Baden*. Mit 4 Karten und 5 Tafeln. Bettmann, Prof. Dr., *Lupus Follicularis Disseminatus*. Würzburg. A. Stuber's Verlag (C. Kabitzsch) 1903.

The first number of this series of contributions to the clinical study of tuberculosis which will appear in occasional issues under the editorial supervision of Prof. Brauer, of Heidelberg, was issued in January, and as it contains a number of interesting articles we give a brief review of its contents. The plan of publication provides for an arrangement of three to five numbers in a volume with a complete index, and the purpose of the "Beiträge" is to present detailed clinical observations, the value of which is not necessarily altered by the state of the present views held on the subject. These contributions are intended to assist in our knowledge of the nature of the devastating pandemic, tuberculosis, and in the successful defense against this enemy. In addition to clinical reports, the articles will deal with the various theoretical questions connected with the subject, and an opportunity will be given for the expression of views differing from the opinions now prevalent on the nature and treatment of the disease. In this way, the practical physician will be kept informed as to the newest movements in this field and will thus be enabled to enrich his knowledge as to the methods of diagnosis and treatment in tuberculosis. With this aim in view and with an editorial force that includes the names of a number of astute workers in the field of tuberculosis, the "Beiträge" promise to become an important addition to the copious literature of tuberculosis that has had its origin in Germany.

1. *The Occurrence of Tuberculosis in Cigar Factories*.—Prof. L. Brauer contributes a very complete study to the question of tuberculosis among cigar-makers in the north of Baden and in the Bavarian Palatinate. The question as to the influence

of the cigar factory upon the spread of tuberculosis has given rise to considerable differences of opinion, principally on account of the difficulty of analyzing the statistical data pertaining to this industry. Many cigar-makers in the regions studied, pursue their vocation at home with the assistance of wife and child, but the majority work in factories. On entering such a factory the penetrating odor of tobacco is noticeable; it excites cough by irritating the throat. While the amount of dust which is generated in cigar-making is moderate, vegetable dust such as that of tobacco sinks very slowly, and is therefore more apt to be inhaled. A part of the material for the author's study was obtained in the medical clinic of Heidelberg. In ten years (1889 to 1898) 10,751 patients were admitted into this clinic, of which 376 were cigar-makers. Of these 96, or 25.5 per cent. had tuberculosis while of the remainder 1,350 or 13.1 per cent suffered from this disease. These figures show a noteworthy prevalence of tuberculosis among cigar-makers. In a second series of cases, obtained from the records of the chief medical insurance association (*Krankenkasse*) of a town situated relatively high in the Valley of the Rhine, in which 40.19 per cent. of the members were cigar-makers, it was found that 4.6 per cent. were disabled on account of tuberculosis for over a week, each year during eight consecutive years, and that $13\frac{1}{3}$ per cent. of all cases of illness including injuries, etc., for which the association paid from its fund, were cases of tuberculosis. Tuberculosis was found in 3.7 per cent. of the members of this association—an unusually large percentage. In order to secure further data as regards the influence of cigar-making upon tuberculosis, the author analyzed large series of statistics of morality in these districts. He found that not only is tuberculosis more prevalent among cigar-makers than among persons in other occupations, but also that it increases with the establishment of every new cigar factory. He does not think that other circumstances than those attending their occupation were brought into play in producing this increase in the frequency of tuberculosis, but that it was due to the peculiarities of the cigar-making industry itself. One of the factors in the increase of disease among cigar-makers is the employment of women and children in these industries and the close association of the two sexes which brought about early and promiscuous sexual relations. In addition to the visitation of the respiratory passages by the inhaled tobacco-dust, which leads to the development of chronic catarrh of the nose, throat and bronchi, thus predisposing to tuberculous infections; the position of the cigar-makers during their work, with the upper part of the body always bent forward may also have something to do with their tendency to contract this disease. A very important cause of the spread of tuberculosis among cigar-makers, moreover, is the inhalation of tubercle bacilli from the sputum which is expectorated by some of them on the floor, and which dries and is swept up with the tobacco-dust into the air of the room. Every tuberculous workman is therefore a great source of infection to his companions. It was thought by Walther that tobacco-dust kills the tubercle bacillus, but this has been disproved by Korn after a series of experiments. Cigar-makers generally sit very close to one another, and therefore there is additional danger of inhaling particles of moisture when the patients cough.

The measures to be adopted in cigar factories for the prevention of these evils can be readily deduced from what has been said before. The chief measure is the exclusion of all working men affected with tuberculosis, who should be placed in sanatoria where they can be taught another trade. Spittoons must be provided, and their use

taught. The floor must never be swept dry but always with a wet broom and must be disinfected with lime once or twice a week. The workmen must not be allowed to sit close together, and the shops must be properly ventilated, with mechanical provisions for the removal of the tobacco-dust.

The Spread of Tuberculosis in Baden. By Dr. W. Hoffmann, Assistant in the Pathological Institute.—The author studies the various factors which influence the spread of tuberculosis in the Grand Duchy of Baden. He found, after a study of the statistics in the Grand Duchy, that the mortality from tuberculosis among the inhabitants is lowered as the altitude above the level of the sea increases. This lowering of the mortality is increased by the fact that agriculture is more frequently pursued in the higher altitudes; that the density of the population is less marked there, and by certain factors the nature of which is still but little understood, but which depend directly upon the geographical altitude. As regards the influence of certain occupations upon the spread of tuberculosis among the population, the following factors must be considered:

1. The percentage of inhabitants who pursue each occupation.
2. The number of persons who are actively engaged in work within the various occupation-groups. A large percentage of women employed in a given occupation increases the frequency of tuberculosis in a group.
3. The influence of the occupation itself upon the health and the increased danger of infection existing in the workshop. In general, the mortality from tuberculosis increases with the increase of industrial occupation, and decreases with the increase of agriculture. No influence could be traced statistically to poverty, to diet, or to the amount of alcohol consumed, but further results may be expected from an analysis of the figures in detail. A contrast was found in the geographical distribution of cancer and tuberculosis, as the latter disease gives the highest percentage of mortality in the North, while cancer gives greater figures of mortality in the South. The influence of race as a predisposing factor is probable, but for the present it cannot be exactly demonstrated. A series of elaborate diagrams and charts illustrating the various statistical relations of tuberculosis in Baden is appended to the article.

Disseminated Follicular Lupus. By Dr. S. Bettmann.—The author reports a case of disseminated follicular lupus which came under his observation in the dermatological department of the medical clinic at Heidelberg. The patient was a woman aged 26 years, with a negative family history, who had never shown signs of any form of tuberculosis. Nine months before admission, she had noticed a macular eruption upon her face which gave rise to a burning sensation and later became punctated. In a few months this eruption spread over the entire face, after which it ceased spreading, except that a few lesions appeared upon the fingers and then upon the forearm. The eruption on the face was painless, but that on the fingers and forearm was quite painful at times. On examination, the eruption was found to resemble an acne vulgaris, and to consist of a large number of isolated lesions which spread all over the face but were most numerous upon the forehead and on the eyelids. The individual lesions were of the size of a pinhead, or a little larger, some of them were distinctly prominent and of a bright red color; others projected but slightly over the level of the skin, or were even depressed and were rather of a brownish-red color. Most of them were surmounted by a small whitish-yellow point which on closer examination proved to be a scale or a mass of epithelium. The lesions were arranged in corres-

pondence with the hair-follicles. On pressing a piece of glass over this eruption, the lesions appeared as brownish or brownish-yellow, gelatinous, translucent infiltrations, thus showing the characters of lupus vulgaris. The diagnosis of disseminated follicular lupus was made and was confirmed on microscopic examination. The structure of the lesions was found to be that of tuberculous nodules of the skin. Tubercle bacilli were not found in the lesions; a positive result with the tuberculin test was obtained after the third injection. The inoculation of particles taken from the lesions into the anterior chamber of the eye of rabbits, gave negative results. In spite of various modes of treatment the eruption remained virtually unchanged, but the lesions on the hands and forearms spread and multiplied and new lesions appeared upon the legs. The latter, however, were not identical with those of the face but were lesions of "acnitis" a sub-variety of tuberculides. The author believes that the diagnosis of lupus was correct and favors the use of the term "lupus follicularis disseminatus" to designate such cases. A review of the literature on the subject is appended to the article, and the position of this disease with reference to the tuberculides is discussed. Bettmann does not believe that disseminated follicular lupus should be ranked among the tuberculides, but he admits that it is closely related to these eruptions. On account of its exanthem-like dissemination it seems to represent a transition between tuberculosis of the skin and the tuberculides. (The tuberculides are diseases of the skin, to which this term has been applied by some French authors, that occur in individuals who sooner or later prove to be tuberculous, but do not show the presence of tubercle bacilli. Boeck calls them tuberculous exanthemata and believes that they are caused by a distant action of the tubercle bacilli upon the skin). The author does not favor the theory suggested by Saalfeld that disseminated follicular lupus represents the transition between lupus vulgaris and lupus erythematosus.

LESSONS AND LABORATORY EXERCISES IN BACTERIOLOGY. An outline of technical methods introductory to the systematic study and identification of bacteria, arranged for the use of students. By Allen J. Smith, M. D., Professor of Pathology in the University of Texas, Galveston. Philadelphia: P. Blakiston's Son and Co.

This volume arranged for the use of students in the University of Texas would hardly meet the requirements of a laboratory guide in most medical schools. Practically nothing is given concerning the methods of isolating and determining pathogenic forms and it is chiefly this knowledge which the medical student desires and ought to obtain. That he should also obtain some knowledge as to the place in nature of bacteria, their life history, products and a thorough knowledge of disinfection, sterilization, methods of culture, media, etc., is not to be doubted.

As yet no satisfactory classification of bacteria has been made. Their minute size and our lack of knowledge of their physiological processes has prevented this. Following Migula and Chester, this book contains an elaborate classification and a very complicated description of the cultural characteristics of bacteria. From a purely botanical stand-point this method of study may be advantageous, but for the medical student in the study of bacteria and their relationship to disease it is questionable whether so much time should be devoted to so much artificial classification and so little practical bacteriology.

H. H. W.

ORIGINAL CONTRIBUTIONS.

DISPENSARIES FOR TUBERCULOSIS, WITH A DESCRIPTION OF THE TUBERCULOSIS DEPARTMENT OF THE BOSTON DISPENSARY*.

BY EDWARD O. OTIS, M. D., BOSTON.

In Germany, France, Belgium, England and Portugal dispensaries or polyclinics for ambulatory cases of tuberculosis already exist; and in London, Manchester and Edinburg, such institutions have been in operation for many years in connection with the consumptive hospitals in those cities. Prof. Fraenkel, of Berlin (*Zeitschrift für Tuberculose und Heilstättenwesen*, Band II., Heft 2, 1901, p. 101), after describing the quite extensive one in Berlin, mentions others established as a part of a general polyclinic in Kiel, Greifswald, Marburg, Halle, Bonn, Breslau, Stettin and Wiesbaden. At the British Congress for Tuberculosis held in London in 1901, Dr. A. Calmette, of Lille, France, gave an extended account of the "Émile Roux" Anti-tuberculous Dispensary, which was opened in February, 1901, and refers to others as already established or in the process of organization in France. At the recent International Tuberculosis Conference held in Berlin, October, 1902, under the section of polyclinics and dispensaries, Dr. Lancastre, of Lisbon, presented a paper upon the value of dispensaries in the struggle against tuberculosis, the inference being that he conducted such a dispensary in Lisbon. Bogaert also described such a dispensary at Antwerp, (*Tuberculosis* Vol. 1, No. 2).

The value of such institutions in the large cities, particularly in the manufacturing ones, whether independent or as a special department of a general dispensary or out-patient department, is, I think, quite obvious in view of the present activity in the control and relief of pulmonary tuberculosis. There are, however, so far as I am aware, surprisingly few of them in this country. For the most part the custom has been to receive ambulatory tuberculous or suspected tuberculous patients in the general medical clinics of the dispensaries, where, of necessity, they received only the small amount of time and attention that could be accorded to any one patient of a large clinic; and also in proportion to the interest of the physician, who happened to be on duty, in this class of cases. Consequently, such patients must frequently, at least, fail in receiving that careful consideration in regard to diagnosis (including a

*Read before the American Climatological Association at Washington, May 13, 1903.

bacteriological examination of the sputum, tuberculin injection and X-ray examination when necessary for the diagnosis), treatment, and proper instruction as to the safe disposal of the sputum requisite in such cases. It is doubtless true, as Biggs says ("Sanitary measures for the Prevention of Tuberculosis in New York City and their results," Hermann M. Biggs, M. D., reprint from the *Journal of the American Medical Association*, Dec. 27, 1902), that many cases escape detection on account of the insufficient examination given patients, and that incipient tuberculosis is frequently not diagnosticated in the dispensaries. Moreover, the majority of tuberculous individuals must, if treated at all, be treated at home. Consumptive hospitals and sanatoria can, at the best, receive only a small proportion of the great army of sufferers from this disease. Still further, one of the most valuable and efficient means of prevention is the supervision and control of the consumptive at his home, and instruction as to how he can avoid communicating his disease to other members of his household.

Such clinics also offer valuable material for research and investigation, as well as for instruction in diagnosis. It is evident, then, that the scope of such a special clinic for tuberculosis is almost unbounded, limited only by the facilities at the command of the physician and his own enthusiasm; but as the physicians are presumably selected for their especial interest in this department of medicine, this latter ought to be great. There is but one objection, that I have met with, to such a special department in a dispensary, and that is the disinclination of those in charge of general medical clinics, and who give clinical instruction, to part with a class of patients valuable for teaching auscultation and percussion and physical diagnosis. This objection, however, I think can partially, at least, be obviated by lending suitable patients of the tuberculous clinic to the general medical men for purposes of instruction; at least this can be done when all the various clinics, as is generally the case in this country, are under one roof.

The Boston Dispensary, where the department about to be described has its habitat, is a venerable institution of over a hundred years' existence, established and maintained by private endowment. It is situated in a thickly settled portion of the city, surrounded by tenement houses and small shops, and in close proximity to one of the great thoroughfares of the city. It draws its clientage from all over greater Boston and beyond; and the average daily attendance is from 250 to 300, not infrequently reaching a maximum of 475 or 500. All the special departments

of medicine and surgery are represented there, even to a clinic for mental diseases. There is this advantage, at least, in having the tuberculosis clinic in the same building with the other special departments; patients can be referred from other clinics to yours, and in turn you can easily and at once obtain an examination of the throat, ear, eye or any other organ when desired.

After careful consideration and some opposition, the tuberculosis clinic was established, as an experiment, in 1899, and at first held a session two or three days in the week; later its growth demanded a daily one. The whole number of positive cases of tuberculosis treated during the last year was 275. Although it has since enlarged its scope and name to diseases of the lungs, its prime interest and attention has always been consecrated to tuberculosis. The change was made, for one reason, in order to facilitate the differentiation of patients by the admitting clerk, for if, for example, a patient presented himself complaining of a cough, it was impossible to say, off hand, whether it was due to bronchitis or tuberculosis.

The clinic is held every forenoon at the same time as the others in the building, and lasts from two to three hours. The physician in charge has a number of assistants, young physicians or medical students, who take histories, examine sputum, and aid in other ways preparatory to the examination by the attending physician. A careful history of the patient is taken on cards, like the one here exhibited:

BOSTON DISPENSARY—DEPARTMENT FOR DISEASES OF THE LUNGS.

| | | | | |
|---------------------------|-----------------|-----------|----------------|------------|
| No. | Date | Diagnosis | | |
| Name | | Age | M. S. W. | Occupation |
| Residence | | | | Birthplace |
| Family History | | | | |
| Habits | | | | |
| Exposure | | | | |
| Past History | | | | |
| Present Illness | | | | |
| T. P. R. | Standard Weight | | Present Weight | |
| Mensuration | | | Lung Capacity | |
| Sputum | | | | |
| Investigation of Domicile | | | | |

These cards are subsequently catalogued and filed for future reference. The pulse, temperature, and respiration are noted, together with the present weight in comparison with the normal. All patients are then stripped to the waist and a careful physical examination is made according

to the usual methods. The sputum is then and there examined, when it can be obtained, by an assistant whose especial duty this is. A water spirometer is also at hand for obtaining the vital capacity of the lungs, although this is not done as a routine practice for lack of time. If the diagnosis is in doubt, the tuberculin test is used, for it has been found that this test can be successfully applied with ambulatory patients. There is also an X-ray room in the same building, and this aid to diagnosis can also be used.

At Calmette's dispensary at Lille, the following is the plan of medical examination :

- I. Chest measurements, in circumference.
 - II. Weight.
 - III. Expectoration, nature and quantity of the sputum, presence or absence of bacilli ; presence of microbes.
 - IV. Register of physical signs in the lungs by graphic method.
 - V. Examination of the circulatory functions ; examination of the digestive, renal and cutaneous functions.
 - VI. Examination of the larynx if it seems necessary.
- At the end of a month another examination is made.

If the diagnosis is established at the first examination, which, of course, is not always possible, the name and address of the patient is given to one of the "district" nurses for investigation of the home conditions—sanitary, personal, social and financial, according to a list of questions furnished the nurse, and modeled after Calmette's form of inquiry, a copy of which is herewith presented:

TUBERCULOSIS INQUIRY.*

| | | | |
|---------------------------------|----------------|-------------|------------------------|
| Nurse's name, | | | Dist. Nurse Asso. |
| Date, | | | record number, |
| | Hospital | | Asso. Charities |
| | number, | | Conference, |
| Name, | | Residence, | |
| Age, | S. Occupation, | Birthplace, | Father, Time in U. S., |
| | M. | | Mother, " in city, |
| | W. | | |
| Family, | | | |
| Deaths in family, ages, causes, | | | |
| Association with Tbc. | | | |

* At present the nurses are using a shorter form of inquiry for lack of time, but later a fuller one is to be undertaken under the auspices of an existing "Association for the Relief and Control of Tuberculosis".

What and how much work can patient do { at home?
 { elsewhere?
 Earnings of patient, Of family, Other support,
 When did patient give up work? Why? Date of first symptoms,
 Work of man,
 wife, children,
 Children at school,
 Name and address of employer of man, wife, etc.
 Patient's opinion of hygienic condition of workshop,
 Income now, Before sickness,
 Debts,
 When and where first known to charity?
 Relief, source and amount,
 Alcoholic drinks used by patient, By father, By mother,
 Patient ever been in penal Parents,
 or correctional inst.,
 Condition of patient,
 Where does he spit? Does he know how to destroy sputum?
 Does he go out? { How much? Could he more? }
 { How much exercise can he take? }
 Sufficient nourishment, Clothes, Bedclothes,
 Immediate needs of patient and family,
 What help can { employer, charity, trades unions,
 be asked of { relatives, mutual aid societies?
 Situation of house,
 Landlord's name and address,
 How many families in house?
 Rent, No. of rooms, etc.,
 Size of bedroom, Other occupants,
 Separate bed, State of bedding,
 No. of What do they Can they
 windows, look upon? be opened?
 When and where
 is washing done? Where dried?
 Where is water-closet
 and its condition?
 What opportunity is there for taking a bath?
 Cleanliness of patient's room
 and house generally,
 Conditions of hall and stairways,

Is it necessary for patient to change his abode?

Are there or have there been other cases

of tuberculosis in the house?

Has patient previously lived in house in which there was or had been tuberculosis, and where?

How long has patient lived in present quarters?

By the way of explanation I will say that the Boston Dispensary divides the city into districts, and sends a physician daily, one for each district, to all cases of sickness among those too poor to pay a physician, and who are unable to visit the Dispensary. Accompanying each district physician is a trained nurse, furnished by another charitable association called "Instructive District Nursing Association", and it is this nurse who makes the investigation above referred to, visiting the consumptives residing in her district. If proper and sufficient food cannot be obtained by the consumptive himself, arrangements are made with a "diet kitchen" or otherwise to supply it.

To each patient a short one-page circular of advice is given, written in plain language, telling of the danger from the sputum and how to avoid it, together with simple rules of personal and domiciliary hygiene. The following suggestions for the guidance of consumptive patients are contained in the circular :

1. The sputum (spit) coughed up by a consumptive contains the seeds of the disease. If the sputum becomes dry and powdered, these seeds or germs fly about in the air, and anyone breathing them into the lungs is liable to contract consumption, especially if the general health is poor. If the sputum is swallowed it may produce consumption of the bowels.

2. Never spit upon the floor, carpet, wall, stove or street. When out of doors, spit into a piece of cloth which must be burned as soon as you reach home. If you have to use a handkerchief, change it frequently, and boil it five minutes before washing. When in the house, use a cup or hand spittoon half full of water, and empty the contents down the water-closet twice a day, or burn them. Wash the cup or spittoon thoroughly with boiling water.

3. Do not get the sputum upon the clothing, bed clothes or hands.

4. When you cough hold a cloth before your mouth. Do not talk or laugh in the face of anyone, for germs may be thrown out in this way. Do not kiss people.

5. Keep your room well aired and clean, without any carpet on the floor, or stuffed furniture. Sleep alone and in a separate room if possible. Keep the windows open day and night.

6. Keep yourself perfectly clean. Wash the face and hands several times a day, and rinse out the mouth. If possible take a cool sponge bath every morning.

7. Do not use any form of alcoholic drink, but drink all the milk you can.

8. Do not get over-tired. Stay out in the open air several hours every day, even if it is not very pleasant weather, for fresh air and good nourishing food are the best remedies for consumption.

9. Be hopeful, and make up your mind that you will get well, as so many thousand consumptives have done; but you must do what your doctor tells you, and have courage, patience and endurance, for it takes a long time to get thoroughly well.

10. Consumptive mothers should not nurse their children, and should not themselves use the children's feeding bottles, cups, spoons, etc.

11. Any room which has been occupied by a consumptive patient should be thoroughly cleansed before being used again.

Whatever drugs are prescribed are obtained from the Dispensary pharmacy at the uniform price of ten cents, or if the patient is unable to pay this, the medicine is given outright.

If the case is an incipient one, or appears to offer favorable chances of recovery under sanatorium treatment, it is referred to the examiners of the State Consumptive Hospital at Rutland, who have an office in Boston. If accepted, we endeavor to aid in securing the four dollars per week required for residence there. This amount does not indicate the actual expense, which is something more than double that sum, but the remainder is paid by the state. If the sum required of the patient (\$4.00) cannot be obtained by him or his friends, the state or city, in a limited number of cases, will pay it, and in others the "Associated Charities" or other charitable institutions come to the rescue. In other cases, failing to obtain this amount from any source, we do the best we can with the patient at home.

If the disease is too far advanced for the Rutland Sanatorium, and yet the condition appears to offer some hope of an arrest, we not infrequently succeed in obtaining, by private appeal, the means to send such a case to one of the numerous extra-mural little sanatoria or boarding houses which have sprung up at Rutland about the great sanatorium, and which are generally maintained by a graduate of the institution. Essentially the same treatment is carried out at these places, and the expense is very moderate. I have met with very gratifying results from a residence in such houses. A young woman, for example, with far advanced disease, after living thus for about a year and a half, lost all cough and expectoration, and has now for a year or more been self-supporting. Another is well and conducting a boarding house at Sharon; while a third is married and economically, at least, well. A few cases we were enabled to send south or west through the instrumentality of a charitable association called the "Invalids' Aid Society", whose object is to send patients to more favorable climates. Other cases, and they were in the majority, we treated at home.

In the city of Boston notification of pulmonary tuberculosis is com-

pulsory, and the efficient Board of Health do valuable work in inspection, instruction and disinfection, and, so far as the accommodations at one of the city pauper hospitals permit, remove dangerous consumptives to it. We can also send a few hopeless cases to the several small private consumptive homes in the city. There is urgent need, however, here as in all large cities, of a large consumptive hospital for such unfortunate cases.

Another service which we render at our clinic is the examination of patients who have been discharged from the Rutland Sanatorium, when desired, or who return after taking the open-air cure elsewhere. Thus, as Calmette says, the dispensary precedes and completes the sanatorium.

As to the equipment, administration and objects of a tuberculosis dispensary, I shall speak directly, but I may be pardoned perhaps if, for a moment, I advert to a few random observations from our experience. First: One may obtain no evidence whatever from a physical examination that any disease exists in the lungs, and yet the sputum may show abundant tubercle bacilli. On the contrary, one may find quite sufficient evidence from the physical examination that tuberculosis, even beyond the first stage, exists and obtain no tubercle bacilli in the sputum. Again, the X-ray frequently shows a greater extent of disease than is indicated by the physical examination. Râles at the apices are not always dependable signs; they are there and they are not, and often, like the Arab, fold their tents and quietly steal away; they must be fortified by other corroborative evidence. By carefully observing the act of inspiration the diseased apex can often be detected at once by the lessened expansion on that side. Vocal fremitus is very frequently more pronounced over the right apex even when there is very considerable infiltration at the left apex. When the temperature is normal, the pulse rate below 80, and the respiration but little if any above normal, the presumption is strong that no tuberculosis exists. The subjective symptom of night sweats may be misleading; patients often complain of it when, from the other symptoms, it is probable that this sign, as we understand it, does not exist.

And, finally, I have experienced more genuine and expressed gratitude from my poor consumptive patients than from any other class. "Honey is not sweeter in your mouths, and light is not more pleasant to your eyes, and music to your ears, and a warm cosy bed is not more welcome to your wearied legs and head, than is the honest, deep gratitude of the poor to the young doctor", says good Dr. John Brown, and I can add, "to the old doctor as well".

As to the material equipment and arrangement of a tuberculosis dispensary, that depends upon the means at command. I use a portion of a large general waiting-hall for my waiting room, and one large room for examinations, using booths made of screens in lieu of special examining rooms. The sputum is also examined in the same room. Three days in the week we have the use of two small adjoining rooms. We can have from four to six patients in the process of examination at one time. In Berlin the clinic is held in a building especially devoted to its uses. On the first floor are various rooms for the reception and examination of patients, and in the second story are laboratories for the examination of sputum, animal experimentation and bacteriological research. At Lille the anti-tuberculosis dispensary consists of a building erected especially for the purpose, divided into six rooms ; a waiting-room, two consulting or examining rooms, a dark room for laryngoscopic examinations, a laboratory which can also be utilized for a third consulting room, and an office for the visitor who visits and investigates the patients at their homes. In the annex there is a laundry for the sterilization and cleansing of the patients' linen, which is brought there in boxes. Pocket and table spittoons and antiseptics are furnished free. The Lille Dispensary also furnishes food to the poorest patients, and sometimes fuel and bedding. The Dispensary of Montmartre, at Paris, consists of a large waiting-hall, an examination room, one for inhalations and respiratory gymnastics, another for X-ray examinations, and a dressing room.

Calmette, the founder of the Lille Dispensary, considers the altruistic motive the impelling one in the establishment of such institutions, for their chief mission, he says, should consist in searching out and attracting the working people attacked with or suspected of tuberculosis, by means of propaganda disseminated intelligibly in populous centres ; in affording free consultation and advice for their families ; in distributing free among them spittoons and antiseptics, and, as frequently as possible, gifts, food, meat and milk.

The equipment of the Berlin Dispensary, with its several laboratories, might indicate that the scientific motive was the primary one, characteristic of this people, but Fraenkel (*Münchener medicinische Wochenschrift*, 1900, vol. 47, p. 686) gives as the chief objects of such dispensaries : First and foremost, to make an early diagnosis, and facilitate the sending of patients to a sanatorium ; second, when this cannot be accomplished, to treat the patients at home ; third prophylaxis, by teaching the patients to avoid communicating the disease through the sputum and drop infec-

tion. In the struggle against tuberculosis, he continues, the sanatoria form the regular line of battle, and the polyclinics the irregular or skirmish line, acting as a support to the regular line of battle.

It has been my experience that we do get a considerable number of early cases in such dispensaries, and although I should hardly argue with Fraenkel that their *chief* object is the early detection of tuberculosis, it is at the same time, a very important one. If I were to formulate the objects of the tuberculosis dispensary according to my own conception and experience, they would be somewhat as follows :

A. As complete an investigation of the patient as possible, including history, physical and bacteriological examination.

B. Investigation of the patient and his entourage at his home, including the hygienic conditions of his domicile.

C. Instruction, both of the patient and his household in hygiene and the safe disposal of the sputum.

D. The free supply to poor patients of pocket and house spittoons.

E. Securing entrance into sanatoria for curable cases, and into consumptive hospitals for incurable ones, who cannot be properly cared for at home, and, when neither is possible, treating the patient at home.

F. Aiding poor patients to obtain suitable food and other articles necessary for their proper care.

G. Affording an opportunity to physicians to send their poor patients for diagnosis when desired, as well as advice and assistance in treatment.

H. Opportunity for the scientific study and investigation of tuberculosis.

I. Clinical instruction to students and physicians in the examination of tuberculous patients.

The equipment of such a dispensary should consist of a separate waiting-room ; a receiving or consulting room, where histories are taken, together with the pulse, temperature, respiration and weight ; several small examining rooms ; a small laboratory for the examination of the sputum and other bacteriological investigations ; a dark room for laryngoscopic examinations unless a throat department exists in the same building ; and possibly an X-ray room. These rooms should be well ventilated, and periodically disinfected. There should be a staff of four chief physicians, each serving three months, with plenty of assistants, either young physicians or third or fourth year medical students.

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HOME AND SANATORIUM TREATMENT OF TUBERCULOSIS.*

BY WILLIAM PORTER, A. M., M. D., ST. LOUIS.

At first glance my subject would seem susceptible of two divisions, but practically it is one thought. We are in the midst of a thorough and effective revolution in our conclusions not only as to the curability of tuberculosis but also as to the means for accomplishing that cure. A few years ago the physician aimed at little more than some general and time-honored prescription and a parting benediction to a climatic Eldorado, with little thought or knowledge of the special fitness for the individual case. The desire on the part of the patient to do some great thing was gratified and the physician relieved of at least one of his many responsibilities.

In the last decade the careful student in this field has compiled certain facts regarding tuberculosis. He finds that it is a communicable disease ; that it is limitable ; that the specific germ is not a virulent one as in diphtheria, or so readily transmissible as in yellow fever or small-pox. He has gained certain knowledge regarding its communicability and has formulated methods to limit it in the home, the workshop and school. In the individual, he has seen that the invasion and multiplication of the specific germ depends largely on lessened local resistance and perverted function and that the process of advance is slow. As a fitting practical deduction, he has found that tuberculosis is curable under the same conditions in which most other diseases are curable.

With these facts before him, the physician has begun to formulate new methods in general and to make more careful study of the individual. The result of his experience has been the coming into favor of the home and sanatorium treatment of tuberculosis and a marked diminution of the death rate from this cause in countries where such treatment has obtained most favor. If we would limit tuberculosis, there must be a system of education for the public and special care for the individual. In our anxiety for the one infected, we too often forget our responsibility for the many as yet unaffected. The latter is the greater need and in working out the problem of protection, the sanatorium should be as potent as in caring for the sick.

In considering the value of the modern sanatorium as a factor in limiting tuberculosis I want to speak briefly of :

I. The demand for the sanatorium.

*Read before the St. Louis Medical Society, March 28, 1903.

2. The protection afforded the public by the removal of tuberculous cases and by practical instruction in the laws that govern the transmission of tuberculosis.

3. Some of the methods employed for the restoration of the individual.

4. Results.

The demand for the sanatorium for the tuberculous is based upon three propositions—the universal prevalence of the disease, the futility of other methods and the adaptability of sanatorium regime to the indications for treatment.

I need not in this society more than refer to the great mortality from tuberculosis. It is generally conceded that one-seventh of all deaths are due to consumption and that one-sixth of all mankind is tuberculous. In other words, at present rate, 10,000,000 of those now living in this country will die of tuberculosis, or 430,000 in our state and nearly 100,000 in our city. Let me here suggest parenthetically, that if by proper instruction in hygiene and care of the sputum as taught at the sanatorium, one in four of these victims could be saved, it would mean two and one-half millions in the United States alone and over 100,000 in Missouri. Yet this is not utopian.

Other methods have proven inadequate. It is now admitted that there is no special climate for the tuberculous. It is not so much locality as it is out-of-door life. The very best results in this country are being obtained in sanatoria in New York and Massachusetts, while the worst are, I truly believe, in Arizona and New Mexico. Not that there is anything inimical in climatic conditions there, but that there is no adequate compensation for the privations, nostalgia and non-systematic living, nor sufficient guard against new infection from the crowding together of careless and ignorant sufferers. Those cases that do well by changing climate should do equally well in a well conducted sanatorium or, as I truly believe, in the home, after intelligent instruction in personal care. I know that this statement will not be universally accepted but the sentiment is growing none the less.

One of our highest authorities (Knopf) says: "If I had to choose between sending a patient to what is usually considered an ideal specific climate but where he would live as in an ordinary health resort, or keeping the patient at home in a fairly pure atmosphere and applying the hygienic and dietetic treatment under constant medical supervision, I

should choose the latter and think the patient had a far better chance of recovery."

In a very elaborate work, Blumenfeld has given the results of his daily observations throughout the year, of the influence of the various meteorological changes exerted on a large number of phthisical patients. His conclusions prove what Dettweiler has been preaching for twenty years, that temperature, atmospheric pressure and humidity scarcely influence the condition of the consumptive. Weber, Dujardin-Beaumetz and von Leyden have voiced the opinion that the successful treatment of consumption is possible where there is pure air, good food, proper hygienic conditions and carefully regulated exercise.

My second proposition is that the sanatorium is protective to the general public. If it be true that an advanced case may expectorate seven billions of bacilli daily, if these bacilli are viable for days under proper conditions of heat and humidity, certainly each case taken from the home or the public thoroughfare is one less source of danger. Not only that, but the sanatorium methods for the care of the sputum can be taught in the home. May I again urge this on my fellow workers in this department?

I believe there are two principal ways for the transmission of the bacilli from the sputum; first by drying of the particles and their inhalation and secondly by unclean utensils and flies. I have more than once caught flies crawling over a cuspidore in which there was tuberculous sputum and found bacilli in the fluid in which the flies had been drowned.

In the home and sanatorium the sputum can be easily cared for. My favorite germicide is the ordinary concentrated lye of the shops. It saponifies every particle of the sputum, thoroughly destroys the bacilli, is non-odorous and cheap. The best sputum cup I have found is the ordinary tin cup with a hinged lid, painted or enameled on the outside. It can be partly filled with sawdust on which is sprinkled some of the caustic lye. When emptied it should be washed in a weak solution of the lye and afterwards rinsed in pure water. Expectoration in anything but the proper receptacles should not be permitted. The same method can be taken with the floor cuspidores which should always be covered. At Mt. St. Rose the individual sputum cups are emptied into the cuspidores, which are of iron having self closing lids. These are taken to the furnace, the lid removed and the iron receptacle placed in the fire for five minutes.

It is not a burdensome matter but a most important one that all eat-

ing and drinking utensils used by a tuberculous patient should immediately after service be put into boiling water, which is a never failing destroyer of bacilli; while clothing that cannot be easily washed should be fumigated in a closed press. This may not be so important in itself, yet it is in line with the care that should be taken whenever practicable and always at institutions.

Thirdly, as to sanatorium methods, the original idea in the erection of sanatoria was the cottage plan. This has given place to the more compact building, with wide halls, rooms freely exposed to light and air, made as nearly germ proof as possible with little wood work, hard finish. Such buildings are more easily heated, ventilated and cared for and there need be no danger either of infection or crowding. The divisions can be so arranged that cases can be classified if deemed best. There should always be numerous verandas and a solarium.

The location as to environment is of much importance, especially if it be near the city. Freedom from smoke and dust, plenty of ground and either natural or artificial protection from north-west winds should be secured. As before stated the geographical situation is not so important. In our own State, much as we disloyally decry our climate, the death roll per 1,000 of population from consumption is only 1.32 while the average for all the states and territories is 1.44.

In every home and at every institution there should be the most perfect ventilation. The demand is not for air at a certain temperature or humidity, or a fixed degree of rarification, but pure unused air that has not been devitalized, containing its full equivalent of oxygen and free from toxic and irritating admixtures. Such air is not hard to find but it is another matter to make the best use of it.

In our work at Mt. St. Rose (and I beg that I may be pardoned if I refer more frequently to it in illustrating this part of my subject) we had at first the greatest difficulty in preventing the patients from closing the windows and doors at night. The question of day ventilation is not difficult with the large halls and verandas, but to supply fresh air to the room or ward without the ever objectionable draught was another matter. The method now in use is satisfactory and is readily adapted to any home. A twelve inch board, resting on edge on the window sill and extending to the side of the frame, is held by hooks two inches from the sash. The raising of the sash to less than the top of the board permits free ingress of air without any direct draught. There is also a guarded opening where the sashes meet. With this simple addition and with

screened transoms which open into the halls, and windows open at each end of every hall, our patients practically sleep in the open air, while in day time they live in it.

Rest and exercise are potent factors in the cure of tuberculosis but they cannot be applied by any general rule. In many cases the patient is restricted in his exercise for the first few days after admission, and if his temperature be above 100°F. he is confined to his bed. The most of our patients take long rests on chairs on the verandas after meals, followed by gentle exercise gradually increased. Chest exercise for lung development is required of all who are able, at regular intervals, and walking parties for definite distances are sent out daily when the weather permits. One of the party carries a pedometer and on no account is a prescribed distance to be exceeded. .

Hydrotherapy is being gradually introduced. So far only the spinal douche has been prescribed for daily use. I believe this is as effective as more complicated procedures, and care must be taken not to tire or annoy the patient. The free use of water internally is encouraged and a number take a teaspoonful of table salt in a glass of water night and morning. Its laxative and alterative effect is often grateful. Pure water should be the companion of pure air in the care of tuberculosis.

The proper clothing for the tuberculous is important. Generally the patient's chest is overclothed. The average case as soon as admitted is relieved of the numerous layers of flannel and chamois, a tepid friction bath is given, light flannels ordered and he is put to rest. When he is permitted to leave his room, very little if any added protection is used around the chest, but care is taken to have the feet and limbs well clothed, but never sufficiently to produce perspiration. No tight fitting corsets or waist bands are permitted.

The dietetic treatment of tuberculosis calls for much care and patience. Not only should the food be varied, but must be often changed at times in each case. To feed a patient to the limit of assimilation without over-feeding him, is a problem. In our institution a mixed diet is used, with eggs and milk as freely as possible. The early morning meal is generally light, followed by egg and milk; an early dinner is given and a mid-afternoon lunch and five o'clock tea. Most of the patients have egg and milk again at bed time. The diet list is somewhat in accord with that advised by Knopf in his work on pulmonary tuberculosis.

The subject of medication is foreign to this paper but there are two indications of which I would speak. One is the weak heart and the other the

incomplete emptying of the lower bowel. The former must be estimated in ordering rest, and as a demand for strychnia and possibly digitalis in small doses; the latter must be considered as a possible cause of afternoon pyrexia from auto-intoxication. My constant practice where the ascending colon is loaded is to give a laxative high enema daily till the bowel is emptied and a normal salt enema each day thereafter. It is most interesting to note the effect of this treatment upon the temperature.

Lastly, what are the results of home and sanatorium treatment? The results of home treatment are hard to estimate, but the reports from sanatoria are valuable. At the great Falkenstein Sanatorium, Dettweiler reports 14 per cent. cures, 14 per cent. relative cures and 45 per cent. improved. At Goerbersdorf the percentage is even better. At the Loomis Sanatorium the cures are over 25 per cent. of all cases and 50 per cent. improved. From the Adirondack and the Winyah sanatoria come the same encouraging reports. Does not this show that at the very incipency of sanatorium work, the one-fourth can be saved and that without increasing the percentage the two and one-half millions before referred to, can be saved.

I wish we were far enough along at our own institution to make a report valuable. We have admitted since the opening just before the first of the year seventy cases. Necessarily many of these have been in advanced stages and the death rate has been correspondingly high. Clinically we divide the cases into three classes, but use a different division for the microscopic evidence. A patient may be in the first stage clinically but show a large number of bacilli, say an average of ten to a field, which would place him in the fifth class in the microscopic record, and we have many of these.

While the time is too short to speak of cures, there are many cases that are most encouraging. From a number the bacilli have disappeared and, as far as we can keep track of them at their homes, they are doing well. One girl has gained thirty pounds during the winter. Several men have gained twenty-five pounds. The greatest gain in weight has been fifteen pounds in four weeks. There has been a marked increase in the average strength and courage of patients in the first and second stages and none of the depression so often found from the association of invalids. Some of the reasons for this are that the patients are not permitted to talk over their condition with one another and that they are kept constantly employed, when not resting, with games, books, cards, needle-work and with the care of flowers. A concert in which some of the patients take part is always a pleasant occasion.

Already a general advance is being made on the "great white plague." In Germany, the home of 64 private and public sanatoria, there has been a wonderful decrease in the number of deaths from tuberculosis. In London there is a decrease and in New York the rate has fallen from 4.42 per 1,000 in 1886 to 2.89 in 1901 and 10 per cent. less than this last year.

The general government is building sanatoria and appropriations are being made by many of the states for this purpose. The sanatorium is not a fad, a mere hypothesis, but a deduction, a logical conclusion based on fact and experience.

Shrady says editorially: "The rational method for treating tuberculosis is, without doubt, for the sufferer to live under those conditions which fulfill in the highest possible degree the laws of hygiene and diet." We are working to an end and to attain it we must have the united efforts of the statesman, sanatorium, physician and the good will of an intelligent people, for as the immortal Pasteur has said, "*It is in the power of man to cause all parasitic diseases to disappear from the earth.*"

THE IMPORTANCE OF THE NERVE CENTRES IN PULMONARY CONSUMPTION*

BY THOMAS J. MAYS, A. M., M. D., PHILADELPHIA, PA.

The student of medicine who regards the pulmonary lesion in respiratory disease as the central disorder around which all the disturbances incidental to these affections rotate, either pays no attention to the physiology and pathology of the brain and nervous system, or deliberately ignores them. The relationship between the two is so discernible and intimate that in many, if not in most respiratory diseases the lung conditions are entirely secondary to a deranged nervous system, and the latter, like a Damoclean sword, hangs over and determines the destiny of the former from birth to death. To the vindication of these propositions this essay is dedicated.

Any one who is interested in the health statistics of any locality knows that a great many more deaths occur from diseases of the lungs than from disease of any other organ in the body. More than this, as many lives are destroyed through the channel of respiratory disease in one year in the city of Philadelphia as accrue from the majority of its most fatal diseases. Again, the death-rate from all diseases in this city, during 1901, was 24,137, one-fourth of which were caused by pulmonary diseases alone. What is the reason for this disparity? Why should one organ be so much more vulnerable to disease than others? Why should asthma, bronchitis, consumption, pleurisy, pneumonia, whooping-cough, and a few minor lung diseases cause so many deaths.

The science of biology furnishes a key for the partial solution of this question. A young organ in a biologic sense is more immature and prone to disease than an older one. This is well shown in the case of the heart, whose biologic age far exceeds that of the lungs. In the lower forms of life this organ is one of the first differentiated structures, and even in mammals it develops and begins its function early in the history of the embryo. The lungs are not seen until in the stage of fishes, where they appear only as swimming bladders without any respiratory capacity. Even in the stage of human life the lungs possess no functional activity until the time of birth, and then they frequently begin in a most precarious manner, as will be seen later on. This difference between the liability of the heart and of the lungs to disease is fully confirmed by the health

*Read by title at the meeting of the American Neurological Association in Washington, D. C., May 15, 1903.

report above quoted, which shows that the deaths from heart disease, during 1901, numbered 1539 or 6.37 per cent. of all deaths, while as already stated affections of the lungs were responsible for the 6511, or 26.98 per cent. of all deaths during the same period, the lungs thus being four times more prone to disease and death than the heart.

But immaturity of the lungs signifies a great deal more than appears on the surface. It means that their nerve supply, the vagi and their nuclei in the oblongata, are likewise immature. In my recent work¹ I collected one hundred and ten cases of phthisis and pneumonia in the great majority, if not in all, of which it was demonstrated that these diseases followed degeneration of the vagi. HOLM² carefully investigated the histology of the vagus nuclei and their fibres in their relation to pulmonary disease in the bodies of seventeen insane, two epileptics, one chronic alcoholic, and one sane person who died of pneumonia. The nuclei and fibres of the vagi were degenerated in every case. The lungs were pneumonic in fourteen, phthisical in five instances and probably normal in the two who died suddenly and unexpectedly from asphyxia and apnœa.

Holm's investigations also confirm the point above referred to, that the respiratory nerves in common with the lungs are slow in maturing. He examined the dorsal vagus nucleus in eleven human fœtuses and sucklings. Six of these were dead-born, two of which were fully formed, and four were 25, 36, 38 and 42 cm. in length respectively. The remaining five were prematurely born, three of which were fully formed, and two were 40, and 41 cm. in length respectively. Two of the latter were 6 weeks, two 12 days, and one 10 days old; two of these died of pneumonia, one of convulsions, and two of atelectasy of both lungs. One of the last was burdened with hereditary syphilis.

The histology of the oblongata was thoroughly made out and it was found that in the six dead-born the dorsal vagus nuclei were undeveloped and devoid of medullated fibres, although the glosso-pharyngeal, hypoglossal, and the accessory nuclei, the solitary fascicle, olivary bodies and the pyramidal tract were developed and at least partly supplied with medullated fibres on both sides. While the dorsal vagus nuclei were undeveloped and without medullated fibres in the six still-born, in the five who were prematurely born and breathed imperfectly for some days,

¹ Consumption, Pneumonia, and Their Allies, E. B. Treat and Co., 1901.

² The Anatomy and Pathology of the Dorsal Vagus Nucleus. By Dr. Harold Holm. *Virchow's Archiv.*, Vol. 131, p. 78.

the dorsal vagus nuclei were developed except in the dorso-lateral part and contained no medullated nerve-fibres. From these and other observations Holm concludes that the vagus nuclei are not fully formed in sucklings for a month or two after birth and that, as a rule, a human foetus of less than 38 cm., in length is not viable. This also conforms with F. GLÖCKNER'S observations who reports¹ the history of three foetuses which were 16, 17 and 23 cm. long respectively, the first of which had made eleven, the second nine and the last eight respiratory movements. They lived from half an hour to an hour and a half, and their lungs were entirely empty of air. Moreover, DOHRN² states, that the lungs of the new-born remain atelectatic for the first three days of life, and that only after the fourth day does respiration become comparatively normal.

It may also be pointed out in this connection, that in all probability the instability and immaturity of the vagus and its nuclei, as seen in Dr. Holm's cases, supply the cause for many of the premature births and still-births which daily swell our mortality tables. Thus in the year 1901 there were 1810 deaths from these sources reported in the city of Philadelphia; and we may legitimately infer, that the defective nervous development which underlies so many pulmonary deaths, is also responsible for a large proportion of non-viable infants.

Having seen that in virtue of the comparative immaturity of their nerve supply, the lungs are primarily handicapped in the race of life, one would naturally expect that disease of the brain, or of the nervous system aggravates the instability of these organs and invites pulmonary disease. Let us see therefore, how this expectation is verified by actual experience. In other words, are those suffering from disease of the brain and nervous system more liable to diseases of the respiratory organs than those who are not? We will hence briefly consider the prevalence of consumption in epilepsy, idiocy, imbecility, and insanity, in this light.

Escheverria in his work on Epilepsy, (p. 313) states: "I have most closely investigated the relations of pulmonary tuberculosis and epilepsy, and undoubtedly the genesis of tubercle in the lungs is favored by the lesion in the oblongata proper to epilepsy. I have traced the pulmonary trouble from its inception, and feel convinced that the association is more than a casual coincidence of both morbid conditions. I have been no less struck with the frequency of tubercles, or other pulmonary lesions which I have met on post-mortem examination of epileptics.

¹ *Centralblatt f. Gynacologie*, 1890, p. 1.

² *Verhandlungen d. deutschen Gesellschaft für Gynacologie*, 3. Congress 1889, p. 107.

Not only does epilepsy produce phthisis in the individual, but the latter is a frequent concomitant of an epileptic ancestry. Herr Dr. BECHEL¹ shows that of the antecedents and collaterals of forty families, each of which had epileptic offspring, pulmonary affections, and particularly phthisis, predominated, while neuroses and insanity were remarkably rare among them.

Dr. Köhler studied the causes of death of 145 epileptics and found that 38, or 26.20 per cent. were caused by pulmonary disease and chiefly by phthisis, while the remainder died of cerebral congestion, epilepsy, typhoid fever, etc. Strange to say a larger number died from phthisis (22) than from epilepsy (17).

The facts in relation to idiocy as a cause of consumption, or *vice versa* are, as far as I have been able to gather them, as follows: The late Dr. Kerlein, Superintendent of the Elwyn Institution for Feeble Minded Children, states² that phthisis exists to the extent of 56 per cent. in one or both families ancestral of the idiotic child, and that if the impartial statistics which accompany his paper had been tabulated by a special advocate to prove that consumption is the main factor in the generation of idiocy, they could not be more startling.

In the article on "Idiocy", in Fuke's Dictionary of Psychological Medicine is a table which gives the causes of idiocy and imbecility in 2380 patients who were received into the Royal Albert and Dareuth Asylum in England. These causes are divided into those which operated before, during and after birth; and among the most potent of these were the family histories of (1) phthisis, 28.31 per cent.; (2) insanity, 16.47 per cent.; (3) imbecility, 4.69 per cent.; (4) epilepsy, 8.39 per cent.; (5) other neuroses, 11.30 per cent.; (6) intemperance, 16.38 per cent.; primogeniture, 20.67 per cent. and infantile convulsions, 27.39 per cent. If these statistics accentuate one thing it is that phthisis plays a more powerful rôle in the history of idiocy and imbecility than insanity, epilepsy, intemperance, infantile convulsions, or any of the other neuroses, showing that phthisis, although differing in its exterior manifestations, is, after all, one of a family of diseases, the foundation of which is noted in the nervous system.

Dr. Langdon Down, Superintendent of Earlswood Asylum for Feeble Minded Children, near London, states³ that the statistics of London show

¹ *Archives de Neurologie*, March 1890.

² *Trans. Penna. Med. Soc.* 1880, p. 172.

³ *Mental Affections of Childhood and Youth*, p. 219.

that the deaths from phthisis constitute 11.50 per cent. of the general mortality. My note of the causes of death at Earlswood indicate that phthisis was the actual cause of death in 39.80 per cent. of the general mortality, rising in some years to the enormous proportion of 57.05 of the general mortality.

The great liability of the insane to phthisis is also demonstrated by the following figures. Dr. T. S. CLOUSTON, Superintendent of the Royal Edinburgh Asylum says¹ that out of 1,082 deaths in that institution, between 1842 and 1861 inclusive, 315 or nearly one-third were due to phthisis. He is satisfied, however, that these figures do not actually express the total number of deaths from phthisis among the insane, for he inspected the post-mortem records of 463 persons who died in that asylum from 1851 to 1863 and found that 277 had pulmonary phthisis. He further states that out of 314 autopsies of the insane who died in the Prague Asylum 151, or 48 per cent., showed evidence of pulmonary phthisis, and that in the time of Georget phthisis was the cause of three-fourths of the deaths among the insane patients of the Salpêtrière.

In the post-mortem examination of 168 melancholics, ESQUIROL² found phthisis pulmonalis and chronic pleurisy in 62 instances, or in 36 per cent. He states that a great many melancholics die from phthisis, whilst organic changes in the brain are rare.

Dr. H. A. TOMLINSON³ superintendent of St. Peter's State Hospital for the Insane, St. Peter's, Minnesota, records that out of 72 post-mortem examinations there was chronic degeneration of the lungs in 47, or in 60 per cent. of the cases. Besides these, six deaths were caused by lobar pneumonia and one by pulmonary œdema.

Dr. R. BOYD⁴, Superintendent of Somerset Asylum for the Insane in England reports that among 519 post-mortem examinations of the bodies of the insane it was found that the respiratory organs were involved in 252 or in 45 per cent. of the cases.

In the post-mortem investigation of 86 bodies whose death was caused by general paralysis, DR. OSCAR MÜLLER⁵, of the Upper Bavarian District Insane Asylum found 36 per cent of chronic respiratory diseases.

Among 607 post-mortem examinations in the Zürcherischen Kanto-

¹ *Journal of Mental Sciences*, Vol. IX, p. 36.

² *Treatise on Insanity*, p. 225.

³ *Transactions of American Medico-Psychological Association*, May 1898.

⁴ *Journal Mental Science*, January 1865.

⁵ *Allgemeine Zeitschrift für Psychiatrie*, 54, 1897-1898, p. 1038.

nalén Insane Asylum of Burghölzli, Dr. ARNOLD BREHM¹ discovered chronic disease of the respiratory organs in 37.70 per cent. of the cases.

In the 1240 observations on bodies of the insane reported by BARTELS² the opinion of Dr. Clouston that phthisis prevails to a greater extent in melancholia than in other forms of insanity, is confirmed. Thus in melancholia, phthisis was present to the extent of 39.65 per cent.; in monomania, 35.59 per cent.; in primary dementia, 30.15 per cent.; and in mania, periodical insanity, paralysis and acute delirium, only 4.66 per cent.

Here then we have the post-mortem records of 4055 deaths, among the insane with 1559 deaths, or 38.50 per cent, from respiratory diseases. When we come to think that the death rate from respiratory diseases among the adult population is about half this number, it is natural to assume that there must be some special reason for the existence of such an excessive death-rate from this class of diseases among the inmates of insane asylums, and that this marked vulnerability lies in a degenerate condition of the brain and nervous system.

Several other very interesting factors develop in the discussion of this subject. One is that both insanity and phthisis were practically unknown among the negroes in our southern states before the civil war; and the other is that since that time both have developed among these people to an alarming degree.

Dr. T. O. POWELL³, Superintendent of the Georgia Asylum for the Insane, states that in 1860 there were only 44 insane negroes in Georgia, and that consumption in the full blooded negro was rarely seen; in 1870, there were 129, in 1880, 411, and in 1890 there were 910 colored insane in that state, which is an increase of 605 per cent. in 20 years. He further states: "I am forced to believe that insanity and tuberculosis are first cousins or at least closely allied. The sudden outburst of insanity with the colored race of the south came associated with tuberculosis, hand in hand, keeping pace one with the other."

Dr. J. F. MILLER⁴, Superintendent of the Eastern Hospital for the Insane of North Carolina, declares that insanity and tuberculosis were rare diseases among the negroes of the South, prior to emancipation, and

¹ *Allgemeine Zeitschrift für Psychiatrie*, 54, 1897-1898, p. 373.

² Die Lungenschwindsucht bei Geisteskranken by Dr. Otto Snell, *Allgemeine Zeitschrift f. Psychiatrie*, Bd. 44, p. 166

³ Report on the Increase of Insanity and its Supposed Causes.

⁴ The Effects of Emancipation upon the Mental and Physical Health of the Negro of the South. *North Carolina Medical Journal*, Nov. 20, 1896.

that in August, 1880, the Eastern Hospital was opened for the exclusive accommodation of the colored insane. During that year insane negroes were admitted; in 1885, 144; in 1890, 244; in 1895, 307; in December 1896, 377 insane colored persons, or an increase of 160 per cent. in eleven years, were under treatment. The death-rate from consumption has also vastly increased among the inmates. In 1884 this disease caused 14 per cent., and in 1895, 27 per cent. of the total number of deaths, and this in spite of a reduction of the general mortality-rate.

Dr. T. J. MITCHELL¹, Superintendent of the Mississippi Lunatic Asylum says that for five years, from 1892 to 1896, the death-rate from consumption among the negro inmates was 43 per cent. of the total number of deaths, and estimating the death-rate among the white population from this disease at 20 per cent., the death-rate among the insane negro population is 23 per cent. greater.

Dr. E. D. BOUDURANT², Assistant Superintendent of Alabama Insane Hospital, states that during three years and nine months, beginning October 1, 1890, 295 deaths occurred among the insane patients of that hospital; 179 among the white and 116 among the negro population. Of the deaths among the white patients 51 or 28 per cent. were due to tuberculosis of the lungs, and of those among the negro patients 49, or 42 per cent. were caused by the same disease. Moreover, consumption assumes a much more active and rapidly progressive form in the negro, so that the average duration of fatal cases is markedly shorter.

Dr. James D. Moncure, Superintendent of the Eastern Hospital of Virginia, informs me in a private communication that the health of the negro in regard to insanity and phthisis was very much better before emancipation than since. Before that time there were about 60 insane negroes in the asylum of Virginia, and now (1896) there are over 1,000. In all hospitals the insane readily contract consumption and this is a frequent cause of death among the insane.

What has caused this tremendous change in the physical status of the colored race? Why should insanity and consumption develop side by side in the same individual? Why should the former precede the latter? Why should this people in the course of thirty years be transformed from the least to the most consumptive race in this country? What are the influences that wrought these changes since, and which were in abeyance before emancipation? This is a profound scientific question, and its solu-

¹ Cited from Dr. Miller's paper; see above.

² Also cited from Dr. Miller's paper, see above.

tion will determine the nature of the causes which originate and propagate pulmonary consumption.

In slavery the negro, as a rule, had comfortable quarters, nourishing food, sufficient clothing, practically no dissipation, and his work was not excessive; the men were employed on the plantations and the women were engaged as cooks, waitresses, chambermaids, and nurses. Dr. Powell says in the paper already quoted that: "Up to and during the war the negroes were the principal nurses for the white consumptives of the south. They washed the spittoons, bedding and clothing of these sufferers, swept and dusted their rooms and, in many instances, slept in the rooms with them, literally living with them night and day, and were more exposed to the tubercle bacillus than now as a general thing; still they resisted the disease."

What then has been the change in the negro's environment since the war? Dr. Miller in the paper already quoted says: "Freedom came to him, and a change came over his entire life. In slavery he had no thought for the morrow, nor did the claims of family either in sickness or in health press upon him, nor worry and affect his mind. But in his ignorance of the laws of his being, the functions of citizenship and the duties and the responsibilities which freedom imposed, demands were made upon him which his intellectual parts were unable to discharge. Immediately the restraining influences which had been such conservators of healthfulness of mind and body were removed; thousands left the quiet homes and regular life of the country for crowded and badly ventilated houses of the town. These were often located in the midst of unhealthy surroundings, and their occupants were without regular employment, eking out a precarious existence. Under his former manner of living he enjoyed a wonderful immunity from brain and lung trouble; and I can confidently assert that the germs of these troubles came to the same man and race in consequence of his changed environment and the manner of his life which followed."

It is also true that the vices of alcoholism and syphilis, which have a special predilection for destroying the integrity of the nervous system, and for producing insanity and consumption in this way, are freely acquired by these people. On this point, Dr. Powell, in the paper quoted above, says: There is a tendency to alcoholic intemperance, not only among the men but also among the women. The direct and indirect effects of syphilis constitute one of the leading factors in the causation of insanity in the colored race. The large number that are tainted with

syphilis in some sections is really alarming. I have ascertained from reliable sources that on some of the large plantations there are few of the adults that are sound and free from the taint of syphilis. I have conferred freely with quite a number of physicians who were actively engaged in general practice before the war, and they agreed that secondary or tertiary syphilis was almost unknown in the country negro at that time. "He relates the following forcible example in regard to the disastrous effects of syphilis on these people: "There were three adjoining plantations which comprised a population of 400 or 500 healthy negroes at the time of emancipation. As a rule they remained on these plantations. Consumption and insanity were altogether unknown among them up to this time. Not long afterwards, syphilis appeared and gradually spread over these plantations. Some ten or fifteen years later consumption and insanity began among the adults, many of their children died from scrofula and tuberculosis, and it was the exception rather than the rule that the children lived. Bodily deformities and idiocy were frequent among them."

From all this evidence does it not appear true that the liability of the negro to insanity and to phthisis is, as Dr. Miller clearly intimates, largely a question of a lower coming in collision with a higher civilization? He is brought face to face with a civilization possessing education, knowledge, and inventions of all degrees and kinds, innumerable arts, sciences, and manufactures, advanced hygiene and sanitation, a multiplicity of industries and employments, burning life-struggles, and proneness to vices and excesses of all sorts, and it cannot surprise any one that in many instances he is unequal to the task of adjusting himself to these conditions and falls a prey to disease. He is like an animal that is confronted by a new geological era to which it must either adapt itself or forfeit its existence. The brunt of the battle falls on the brain and nervous system, since these structures are the instruments through which his efforts are made to bring himself in harmony with his changed relations. He therefore becomes insane and phthisical because his nervous system is undermined by, and disintegrates under the strains and burdens which he is unable to resist or to counteract.

In summing up the data which have been brought together in this paper, the following deductions are clearly justified:

1. The respiratory organs are biologically among the most immature organs of the body.
2. For this reason they are specially predisposed to disease.

3. Degeneration or imperfect development of the vagi or of their nuclei accelerates this tendency to disease.

4. Pulmonary consumption is from two to three times more prevalent in epilepsy, idiocy, and insanity than it is among the non-nervous population..

5. Both insanity and consumption were comparatively unknown among the negroes of the South before the civil war.

6. Since emancipation both of these diseases have increased to an alarming extent among these people

7. These people, as a rule, first become insane and then phthisical.

8. The phthisis death-rate is almost twice as high among the negro as it is among the white insane.

9. This disease is largely and generally the result of a clash between unaccustomed environmental changes and an immature or impaired condition of the nervous system.

ORIGINAL TRANSLATIONS.

ON THE RELATIONS OF THE ACID-PROOF SAPROPHYTES (PSEUDO-TUBERCULOSIS BACILLI) TO TUBER- CLE BACILLI*

BY PRIVATDOCENT DR. FELIX KLEMPERER, BERLIN.

The so-called acid-proof bacteria which have been found with unexpected frequency of late years in grass, milk, butter, smegma, and other substances, have aroused the interest of bacteriologists on account of their close resemblance to tubercle bacilli, a resemblance which has won for these germs the name of "pseudo-tuberculosis bacilli."

It was formerly thought that this similarity was purely external, Moeller, who was the first to grow a series of acid-proof bacilli in pure cultures, and who may be looked upon as having an intimate knowledge of this group of germs, regarded the similarity of these microorganisms as purely external and in his report to the London Tuberculosis Congress in 1901¹ said: "By artificial methods of cultivation the tubercle bacillus and the bacillus of thimothea may be so approximated in their external properties that one of these germs takes up the characteristics of the other. We can accustom the tubercle bacillus to a more rapid growth, to a lower temperature, and we can force the thimothea bacillus to grow more slowly, like the tubercle bacillus, and to assume the external appearance of the tubercle bacillus; and yet the two species will remain distinct."

In a later communication (Verein für Innere Medizin, Berlin, February 3, 1902²) Moeller admits that, "there is a close relationship between the tubercle bacillus and the pseudotubercle bacilli and that this relationship is more close than is indicated by the identity of the color reactions which bacteria of the same group exhibit." Kayserling, who studied the pseudotuberculosis bacillus in Belzig under MOELLER³, also concludes from a consideration of the points of similarity and of difference between these germs and the tubercle bacillus, that "No matter how pronounced the differences may be between the tubercle bacillus and the group of pseudotubercle bacilli, yet the facts which have been cited tend to show that we have to deal here with two related species."

The narrower conception of the relations between the acid-proof bacilli and the tubercle bacilli, is due to the fact which ROBERT KOCH⁴

*Translated for the *Journal of Tuberculosis* from *Zeitschrift für klinische Medizin*, Vol. xlvii, No. 3-4., p. 250.

demonstrated in his work, "On the Agglutination of Tubercle Bacilli and on the Use of this Agglutination", namely, that a serum which agglutinates tubercle bacilli is capable of agglutinating acid-proof bacteria in about the same ratio. The serum of animals, into which acid-proof bacteria have been injected not only is capable of agglutinating these bacteria, but also of clumping the tubercle bacillus. "The different species of this group, which are distinguished by their staining reactions, are so closely related to one another, at least as regards their contents in substances precipitated by the agglutinating serum, that they cannot be distinguished by means of agglutination." Koch, by the way, does not express any opinion as to the nature or the relationship between the acid-proof bacilli and the tubercle bacillus; but it must be noted that in another place in the article mentioned, he speaks of "the close relatives of the tubercle bacillus, the so-called acid-proof bacilli," meaning by tubercle bacilli the tubercle bacilli of birds and of cold blooded animals.

Koch's determination of the mutual agglutinating properties of the tubercle bacillus and the acid-proof bacilli leads to the idea that there may also be relations of immunization between these two groups of bacteria.

Immunity and agglutinating properties do not always run exactly parallel in every case, it is true, and the inter-relation of these two phenomena to each other is not yet perfectly known. It is perhaps unnecessary to discuss here the abundant literature of this question. Yet, the majority of authors regard the reaction of agglutination as a reaction of immunization, and Koch himself writes in the article cited above: "The question as to whether the phenomenon of agglutination itself should be looked upon as an immunizing quality and should be regarded, so to speak, as one of the factors which enters into the complex idea of immunity, I shall leave undiscussed, although I am personally inclined to this mode of thinking. In general, however, we may assume, so far as our present knowledge goes, that the intensity of the agglutinating power and of the immunity occupy a certain definite relation to each other, at least at the beginning of the process of immunization, and that therefore the power of agglutination may be considered as a standard of measure for the degree of immunity attained."

The question may therefore be justly asked, whether the inoculation of animals with acid-proof germs confers an immunity upon them against infection with the tubercle bacillus. In this manner alone could this question be reached from the experimental side, and I proceeded to inves-

tigate it in the beginning of last year, at the bacteriological laboratory of the Institute for Medical Diagnosis. The following report contains the results of my work.

For the preliminary inoculation of the animals I employed the bacilli of grass, and of milk, which were kindly furnished me by Mr. Möller (of Belzig) and also bacilli from butter which had been grown in our laboratory for some time. All three growths were highly resistant to acids and on microscopical examination resembled the tubercle bacillus very closely, in some cases so closely as to be easily mistaken for Koch's germ. The cultures were distinguished with ease from the tubercle bacillus cultures, inasmuch as all three showed an abundant growth, even after twenty-four hours, appearing as a moist and pasty film of a yellow tint. The intensity of this color seemed to be very variable and to depend upon the composition of the nutrient medium, and the milk bacilli especially were often nearly colorless. The moisture of the cultures also seemed to be at times very slight and in transplanted cultures from a second animal it was often delayed and scanty, so that the culture did not look unlike cultures of tubercle bacilli.

The only animals that could be considered for these experiments were guinea-pigs, as they alone constitute a trustworthy reagent for the tuberculous infection which was to follow. The fresh sputum of patients with tuberculosis was invariably used for the tuberculosis infections. In the numerous cases of tuberculosis in my poliklinik, I have access to patients whose sputum contains enormous numbers of bacilli, almost in pure culture. From such a sputum, which had been freshly expectorated, and had previously been washed, I took ten small flocculi and rubbed these with 1 c. c. of bouillon in a mortar until the fluid was perfectly uniformly opaque. Of this dilution 0.2 c. c. were injected subcutaneously, and the control animals received in every case the same amount out of the same syringe. That this represented a very large infectious dose may be judged from the fact that all the control animals died within the first four to six weeks, and but few survived to the seventh or eighth week, while all of them showed extensive and advanced tuberculosis of all the organs.

The preliminary inoculation of the guinea-pigs with acid-proof bacilli proved to be very much more difficult than had been expected, for the majority of these animals succumbed to these inoculations. It had been generally known that these germs could produce pathogenic effects, but Kayserling, for example, had found that of twelve guinea-pigs inoculated

with the thimothea bacillus, only three had fallen ill, while of four inoculated with butter bacilli, only one showed morbid signs. The loss in animals was much larger in my own experiments, and only a small fraction of my animals survived, especially at the beginning of the work. This is explained by the larger numbers of bacilli injected, and also particularly by the more frequently repeated injections. At first I made all my injections intraperitoneally, and began with one loop of an agar culture from two to four days old, which was diluted in one c. c. of bouillon. After eight days the same dose was given again in the same manner, and after eight more days a solution of two loops was injected. After a time, according to the presence or absence of morbid signs, this injection was repeated once or twice, and then four loops were injected, and so on. Most of the animals died, some of them after the first or second injections; the majority in the further course of treatment. At autopsy there were frequently found nodules in the liver and spleen, which usually were abscess-like, soft and yellowish, more rarely gray and tubercle-like. There was almost always a peritonitis with extensive adhesions and cicatricial areas in which there were smaller foci of a gray color and larger multiple centres of suppuration. The pleural cavities and the mediastina also frequently contained masses of adhesions which were sometimes very extensive. The acid-proof germs which had been inoculated could be recovered from all the organs affected. A noteworthy fact was that the inoculation with a certain dose of the acid-proof germs did not give a guarantee that the same animal could bear the same dose again at a subsequent inoculation. It is not astonishing therefore that of eighteen guinea-pigs, prepared in this manner, I finally succeeded in bringing two so far that a result could be hoped for from the inoculation of tubercle bacilli. These were the guinea-pigs marked 3 and 9 (experiments 1 and 2), which had borne the intraperitoneal inoculation of twenty-one and fifteen loops of acid-proof bacteria respectively.

The results on subcutaneous inoculation were considerably better. Even in subcutaneous inoculations there occurred abscesses with marked frequency, and in some of the animals there developed the lesions described, with the formation of nodules and peritonitis. In others, however, there were only circumscribed abscesses which healed after opening or spontaneous bursting, or subcutaneous infiltrates or swellings which disappeared gradually by absorption. In some cases there seemed to be no pathologic changes, but even in these animals autopsy showed isolated

nodules in the liver and spleen and a few adhesions in the peritoneum and the pleura.

As they were more easily borne, the subcutaneous injections were begun with two loops of the culture in one c. c. of bouillon, and were pretty rapidly increased to four, six, etc., loops. In some cases they could be raised to twelve or even eighteen loops. In injecting the larger amounts of bacilli, they were dissolved in two or three c. c. of bouillon, the increased amount facilitating a more uniform distribution of the bacteria in the subcutaneous tissues. Recently I have also undertaken the subcutaneous injection of acid-proof bacilli after infection with tubercle bacilli. Of nineteen guinea-pigs in which I have made subcutaneous injections, I have thus far brought six to a certain conclusion of the test.

My observations upon the effects of preliminary and subsequent infection of animals with acid-proof bacilli upon infection with tubercle bacilli therefore comprise altogether eight experiments, the protocols of which in summary are as follows :

EXPERIMENT I.

Guinea-pig 3 (weight 620 grammes) received intraperitoneally :

| | | | | |
|----------------|----|------|------|---------|
| March 1, 1902, | 1 | loop | milk | bacilli |
| March 8, " | 1 | " | " | " |
| March 22, " | 2 | " | " | " |
| April 26, " | 1 | " | " | " |
| May 3, " | 2 | " | " | " |
| May 10, " | 4 | " | " | " |
| May 31, " | 4 | " | " | " |
| June 14, " | 6 | " | " | " |
| Total | 21 | " | " | " |

The weight fell to 520 grammes on May 10.

On June 21, (weight 590 g.) a subcutaneous inoculation (on the abdomen behind) of 0.2 c. c. solution of tuberculous sputum. On July 22, (weight 640 g.) a slight infiltration at the point of infection. On July 29, (680 g.) the inguinal glands were of the size of a pea. On September 6, (670 g.) there was an ulcer at the point of infection of the size of a pfennig, the inguinal glands were slightly enlarged, the animal very lively. On October 27th, (680 g.) the condition was unchanged. On Nov. 15, (640 g.) the ulcer only slightly, the glands markedly enlarged. On December 13, (600 g.) the axillary glands were also enlarged. Died January 14, 1903.

Autopsy : Generalized advanced tuberculosis. Controls : Guinea-pigs No. 20 and 21 received on July 21, 1902, 0.2 c. c. of the same sputum solution in the same place. Guinea-pig 20 died on July 19th, Guinea-pig 21, on July 31, and in both animals a general tuberculosis was found. Guinea-pig 21 weighed 670 grammes at inoculation ; on July 12th, 610 g. ; on July 22nd, 520 g.

EXPERIMENT II.

Guinea-pig No. 9 received intraperitoneally:

| | | |
|-----------------|----|---------------------------|
| April 22, 1902, | 1 | loop of thimothea bacilli |
| May 3, " " | 1 | " " |
| May 10, " " | 2 | " " |
| May 21, " " | 2 | " " |
| May 31, " " | 4 | " " |
| June 14, " " | 4 | " " |
| Total | 14 | " " |

On June 21 inoculation with tubercle bacilli as in guinea-pigs 3, 20 and 21 (controls). On July 19, only infiltration at the site of injection and slight swelling of the inguinal glands. No diminution in the weight (450 g.). On Sept. 6, the weight 390 g.; a skin ulcer the size of a mark piece, and glands swollen to the size of beans. Died October 27th, 1902. Autopsy: Pulmonary and abdominal tuberculosis.

EXPERIMENTS III AND IV.

Guinea-pig No. 23, (690 g.) received subcutaneously in the back:

| | | |
|----------------|---|--------------------|
| June 30, 1902, | 2 | loops milk bacilli |
| July 7, " " | 4 | " " |
| July 14, " " | 4 | " " |
| July 21, " " | 6 | " " |

Guinea-pig No. 26, (630 g.) received subcutaneously in the back:

| | | |
|----------------|---|----------------------|
| June 30, 1902, | 2 | loops butter bacilli |
| July 7, " " | 4 | " " |
| July 14, " " | 4 | " " |
| July 21, " " | 6 | " " |

On June 21, both guinea-pigs and the controls No. 27 (700 g.) and 28 (470 g.) were inoculated in the posterior part of the abdomen subcutaneously with 0.2 c. c. each of the solution of tuberculous sputum (Diagnostic Institute No. 6874).

Guinea-pig 23, died August 17, without discoverable cause (a small abscess at the site of infection in which there were no tubercle bacilli found), the internal organs free from tuberculosis (weight 660 g.). Both controls had at that time small open ulcers at the site of injection, as well as perceptible inguinal glands (weight 640 g. and 390 g. respectively).

Guinea-pig 28 died on August 29, No. 27 on Sept. 10th (the autopsies were not performed as the author was absent), nor were the weighings kept up regularly during the vacation.

Guinea-pig 28 weighed 570 g. on September 20th. An open ulcer of the size of a mark piece on the abdomen. Died November 1, 1902. Autopsy: General tuberculosis.

EXPERIMENT V.

Guinea-pig 30 received subcutaneously:

| | | |
|----------------|----|--------------------|
| July 28, 1902, | 2 | loops milk bacilli |
| Aug. 4, " " | 2 | " " |
| " 11, " " | 4 | " " |
| " 22, " " | 6 | " " |
| Sept. 26, " " | 4 | " " |
| Oct. 2, " " | 6 | " " |
| Oct. 21, " " | 8 | " " |
| Nov. 1, " " | 12 | " " |
| Nov. 15, " " | 18 | " " |

EXPERIMENT VI.

Guinea-pig 33 received subcutaneously:

| | | |
|-----------------|----|-------------------------|
| Sept. 20, 1902, | 2 | loops thimothea bacilli |
| Sept. 26, " " | 3 | " " |
| Oct. 2, " " | 4 | " " |
| Oct. 16, " " | 6 | " " |
| Nov. 1, " " | 8 | " " |
| Nov. 15, " " | 12 | " " |

} Skin
abscesses
opened;
healed.

November 17, 1902. Guinea-pigs 30 and 33 were inoculated at the same time as the controls 34 and 35 with tuberculous sputum (as above) subcutaneously. December 17. Guinea-pigs 34 and 35 showed open ulcers at the site of inoculation and distinct swelling of the lymph-nodes. Guinea-pig 30 showed an abscess of the size of a pea, which broke on pressure. Guinea-pig 33 showed a hard infiltrate of the size of a bean, and palpable inguinal glands.

Guinea-pigs 34 and 30 were killed. In 34 there were caseous inguinal glands, a large spleen, with scattered tuberculous nodules, and the liver also showed a number of tuberculous foci; the lungs seemed to be free.

Guinea-pig 33 showed, in addition to local suppuration at the site of inoculation, a moderate degree of swelling and suppurative infiltration, but no caseation in the inguinal glands. The spleen was small and adherent to the peritoneum in a number of places. It contained a yellowish-white nodule of the size of a small pea, which contained acid-proof bacteria; in the adhesions there were several small nodules, but on section it was smooth. The liver contained a few similar knots, while its surface was almost smooth. The lungs were free from lesions. Guinea-pig 35 died on Dec. 30. Autopsy: Tuberculosis of the abdominal organs and of the lungs.

Guinea-pig 33 died on January 10, 1903. Thickened masses of pus were found at various points in the skin of the back; and in these acid-proof bacilli could be found on culture. In the abdomen were numerous nodules in the spleen and liver, some which looked like abscesses. The inguinal glands showed pus, on section, not cheesy material, in which culture demonstrated the presence of grass bacilli. The majority of the foci was therefore due to grass bacilli, and it was impossible to say how many were of a tuberculous character.

EXPERIMENTS VII AND VIII.

Guinea-pigs 37 and 40 were infected with tuberculous sputum in the same manner as, and simultaneously with guinea pigs 34 and 35, on Nov. 17. They received 3 loops each of acid-proof bacteria (mixture of 1 loop each of milk, grass and butter bacilli). On Nov. 29, they received 6 loops (mixture of 2 loops of each culture) and on December 10, 12 loops of the same (mixture of 4 loops of each culture).

Guinea-pig 37 was killed Dec. 17, and No. 30 and No. 34 were also killed on the same day. Autopsy showed subcutaneous suppuration, from which a culture was obtainable within 24 hours. In the liver there were two yellow nodules which also contained acid-proof bacteria, and there were, in addition, some peritoneal adhesions, while the spleen and lungs were normal.

Guinea-pig 40 received, Dec. 23, subcutaneously 18 loops of the bacterial mixture. Within a few days a large abscess developed upon its back, and the animal which was somewhat neglected during the holidays, was found dead on January 2, 1903. The advanced decomposition renders it probable that the guinea-pig died on Dec. 31. (It had been seen alive on the 30th and the wound dressed). In the abdomen sloughing masses (the stomach shows cadaveric decomposition). Some patches on the liver and spleen but on section no tuberculous lesions therein. The lungs were also free from lesions.

I believe that these experiments show that the injection of acid-proof bacteria produces an inhibitory influence upon tuberculous infection and

creates a certain immunity against the latter. The protection is but slight and transient, but when we consider that the supply of acid-proof bacteria was very limited, for reasons which have already been spoken of, and that the tuberculous infection was a very virulent one, we may regard the protective influence thus produced as positive and distinct. The question which it was intended to solve in these experiments, namely, whether there exist relations of immunization between the acid-proof bacteria and the tubercle bacillus, must therefore be answered in the affirmative.

What significance therefore must now be attached to the correspondence in the phenomena of agglutination demonstrated by Koch and the relations of immunization between acid-proof bacteria and tubercle bacilli shown by me in the experiments above recorded.

When E. von Behring discovered the important fact that cattle which had been treated previously with human tubercle bacilli become immune against pearl disease, he concluded that this behavior is a very strong proof of the unity and identity of the species of tubercle bacilli found in man and in cattle and a refutation of Koch's well known communication to the London Congress of Tuberculosis concerning the non-identity of these germs.

Behring recently has extended his discovery by showing that cattle which have become immune against bovine tuberculosis are also immune against tuberculosis of hens, and that conversely cattle can be protected from bovine tubercle bacilli by treatment with hen tuberculosis bacilli. The tubercle bacilli in Behring's hens have been shown to originate from a tuberculous cow. About forty hens at a certain farm had eaten of the entrails of the carcass of a tuberculous cow that had remained exposed. After three months, a number of these hens became ill and died, and gradually the infection proved fatal in all the exposed fowls. Behring's culture was derived from the last two hens which died two years after the infection, so that the phylogenetic relationship of these germs with the bovine tubercle bacilli can not be questioned. The proof as to mutual immunization which has been spoken of above is regarded by BEHRING⁵ as a still stronger proof for the identity of the two species.

In analogy to this mode of reasoning the conclusion seems inevitable that there exists a close interrelationship between the acid-proof bacteria and the tubercle bacilli; that they belong to one and the same species and are phylogenetically related. The fact that the relations between the two, so far as they show mutual immunization, are but faintly marked,

speaks for the great distance which exists between the two. But these relations are present, and are sufficient to show their kinship. The course of evolution from the acid-proof saprophyte to the tubercle bacillus of man and cattle may have been a very long one, and may have taken a considerable length of time; the distance which separates these two groups may be very great, but yet they are related and are undoubted links of the same chain.

The question arises: Can we bring into agreement with this view the differences which unmistakably and constantly exist between the acid-proof bacteria and the tubercle bacillus?

We will not concern ourselves here with the morphological (cultural) and biological characteristics of the pseudotubercle bacilli. This does not lie within the province of the present study, nor could we add anything new to what has already been found by earlier authors, especially by MOELLER and KAYSERLING⁶. We may say however in brief: The characteristics of the acid-proof bacteria which distinguish them from the tubercle bacilli are their rapid growth at lower temperatures (they grow at room temperature within from 24 to 48 hours), as well as their lack of specific pathogenic powers.

But the same differences, although in considerably slighter degree, exist between the tubercle bacilli of mammals and those of birds and cold-blooded animals. Avian tubercle bacilli thrive at 42°C and over, and develop within from eight to ten days on glycerine agar. The tubercle bacilli of cold-blooded animals grow at 20° to 25°C and cease to grow at 30°C. within from two to four days. Neither is markedly pathogenic in guinea-pigs, for example. And yet their relation to the tubercle of mammals, which require from 30° to 40°C. and which begin to show a visible growth only within ten to fourteen days, cannot be doubted. As regards the tubercle bacilli of hens this has already been proved, and has been discussed above; as regards the tubercle bacilli of fishes, we may refer to the latest investigations of HERZOG⁷, who has produced tuberculosis in fishes by means of human tubercle bacilli and has found that in this process the virulence of these germs was diminished, and that they were thereby brought closer to the tubercle bacilli of cold-blooded animals, so far as preference of temperature was concerned. Differences in growth and virulence, therefore, do not constitute a fundamental distinction in these cases; they may rather be explained as an adaptation of different varieties of the same species of germ to a particular animal.

If we now consider the difference between the acid-proof bacteria

and the tubercle bacilli from the same viewpoint, it cannot be denied that these differences are only quantitatively and not qualitatively different from the distinctions between the tubercle bacilli of mammals and those of birds and cold-blooded animals. While the acid-proof bacteria do not invade the animal organism and do not multiply therein (Möller) nor spread spontaneously, yet they are not without pathogenic powers. They produce nodules resembling tubercles (Lubersch and others), as Möeller showed, when they are injected with butter. Their virulence is slight, but it may be unmistakably increased by passing through a number of animals, whereby the acid-proof bacteria begins to grow less rapidly and the culture approaches distinctly in appearance to cultures of the tubercle bacillus, although, it is true, only to a certain degree. Acid-proof bacteria and tubercle bacilli cannot be converted into each other; their differences remain. This is of great practical importance, but theoretically it does not preclude the conclusion that the acid-proof bacteria and the tubercle bacilli, as well as the tubercle bacilli of mammals and those of birds and cold-blooded animals are phylogenetically related, i. e., belong to the same species, and that there is a continuous evolution from the acid-proof saprophytes through the bacilli of the cold-blooded animals and birds to those of men and the bovine species; with an increased demand as to the quality of the culture medium and the temperature of growth; with a decreased rapidity of growth and an increasing virulence.

It is unnecessary to add that this theory is not of any practical significance; not even in so far as acid-proof bacteria might possibly be employed instead of the tubercle bacilli of birds or mammals for immunization, as Behring has begun to do so brilliantly in cattle. For this purpose the most suitable germs are *a priori*, those which are most closely related to the tubercle bacilli of mammals; and besides, the strong tendency of the acid-proof bacteria to produce suppuration renders them unsuited for practical use. Still less does this view involve the possibility that the acid bacteria can adapt themselves to the animal organism and can become real tubercle bacilli. Experiments show that it is possible with great difficulty to convert the more closely related members of the chain of evolution of which we spoke into one another; for example, bovine tubercle bacilli into those of cold-blooded animals. It is impossible, however, to convert into one another the more remote links, i. e., the acid-proof bacilli into tubercle bacilli. Therefore, from a practical viewpoint, Möeller's dictum remains true: "In their typical property they remain

separate species ; Nature cannot be coerced, and we cannot do anything against her with all our arts of culture." Yet theoretically this does not antagonize the conclusion to which we have been led by the experiment recorded above, namely, that tubercle bacilli and acid-proof bacteria are related, in fact, identical species ; in other words that tubercle bacilli are acid-proof saprophytes which have become parasitic.

LITERATURE.

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- 3 *Zeitschrift f. Tuberculose u. Heilstättenwesen*, Vol. III, No. 1, p. 35, 1902.
- 4 *Deutsche med. Wochenschrift*, 1901, No. 48.
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- 6 *Loc. cit.* KAYSERLING also gives bibliography of the subject, which is therefore omitted here.
- 7 *Centralblatt f. Bakteriologie*, 1902, p. 78.

CONTRIBUTIONS TO THE QUESTION AS TO THE REMOVAL AND DISINFECTION OF SPUTUM BY CHEMICAL AND PHYSICAL METHODS*.

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The fault underlying all the tests that have been hitherto made with a view of determining the best method of disinfecting the sputum of tuberculosis lay in the fact that the observers contented themselves with the consideration of experiments with bouillon cultures, instead of studying the sputum itself and its destruction as it is required in practice.

A fact emphasized by BEHRING¹ has been overlooked, namely, that the chemical composition of the medium in which the bacilli are to be killed, plays a prominent rôle in the question of disinfection, and that the results obtained with other germs, e. g. the anthrax spores, cannot be directly applied to tuberculous expectoration. The experiments conducted in test tubes were not distinguished sharply enough from the requirements of medical practice, nor was sufficient attention paid to the variable virulence of the tubercle bacillus and the resulting constant alteration in the material experimented with. This explains the differences which at times have been obtained in experiments of this kind. For example, BUTTERSACK² found that sputum dried on glass plates was rendered sterile by pouring boiling water over it, for from one-half to two minutes, while SCHILL and FISHER³ report that they have found that dried sputum remained infectious after having been kept at a temperature of 100°C. for thirty minutes. It is only lately that the importance of the varying virulence of the tubercle bacillus in experimental work has been fully realized, especially in the important tests which have been made as to the infectiousness of the germ in experimental inoculation of human tuberculosis into animals (cattle). The many manufacturers of chemical disinfectants advertised with full force, after a series of laboratory experiments which perhaps only chanced to be satisfactory, and thus a number of disinfectants have been placed on the market, each of which was claimed to be superior to the others. It is not surprising, therefore, that the experiments which have been conducted at the Imperial Sanitary Bureau in Berlin by YERSIN, SCHILL and FISHER³ were such as to open the eyes of those who relied upon the claims of the makers.

*Translated for the *Journal of Tuberculosis* from *Zeitschrift für Tuberkulose und Heilstättenwesen*, Vol. 4, No. 2, January 1903.

These observers showed that the solution of mercuric chloride in the strength of one part in five hundred, which has been considered so trustworthy, remains without any effect upon the tubercle bacillus in sputum, and that a five per cent. solution of carbolic acid was effective only after twenty-four hours' exposure to its action. This effect, it must be noted, did not take place unless the sputum was thoroughly mixed with the disinfectant by means of a glass rod, a manipulation which is manifestly impracticable as a matter of routine. Again SPENGLER'S⁴ experiments on guinea pigs with, it is true, only minimal amounts of from one to ten per cent. solutions of aseptol, carbolic acid, creolin and lysol, with an exposure of the sputum to the action of the disinfectant for from three minutes to twenty-four hours, showed that the tubercle bacillus is quite resistant to the action of chemical agents; (five grammes of the fluid were taken in each experiment to five grammes of sputum).

Aroused from this apathy some authors, VON WEISMAYER⁵, (Berlin Tuberculosis Congress, 1899,) recommended the simple mixture of the sputum with water in the sputum cups. CORNET⁶ had emphasized the importance of keeping the sputum moist, as the result of experimental studies. The necessity of care in handling sputum in general, and the importance of cleanliness was thereafter given more prominence—questions of education and discipline. Such clinicians as VON LEUBE¹⁵ at the Berlin Tuberculosis Congress, 1899, and later MOSLER⁷, emphatically urged the adoption of these measures. The sputum was quietly thrown into the sewers, for KOCH^{8a} had shown that tubercle bacilli require a higher temperature than 30°C. in order to grow upon appropriate media; that they grew more slowly than other bacteria, and therefore could be easily overgrown and suppressed. The formation of new spores and the multiplication of the germ in free nature seems therefore impossible. The general opinion seems to be that the tubercle bacillus falls victim to the combined influence of the bacteria of putrefaction, of sunlight and the abundant oxygen supply which obtains in the sewers (KOCH^{8a}, J. STRAUSS^{8b}, MIGNECO⁹ and W. KRAUSE¹⁰). Furthermore, according to LUBARSCH¹¹, the tubercle bacillus represents a type of a more highly organized pleomorphic fungus which is derived from a saprophyte and only becomes dangerous to man when it becomes a parasite in the shape of a bacillus. It has been possible to cultivate experimentally saprophytes from fungi that are closely related to the tubercle bacillus (HUEPPE, PETERSON¹², FISCHEL¹³, MOELLER¹⁴, LUBARSCH¹¹). From this viewpoint the masses of virulent bacilli which are expectorated do not seem to be

very dangerous. "As a general rule, we have but little to fear from the tubercle bacilli which reach the outer world, e. g. in the urine, or in the excrementa, or even in sputum" (VON LEUBE¹⁵).

The experiments of MUSEHOLD¹⁶ were, however, of great weight in deciding this question, for he showed that if sputum containing tubercle bacilli be thrown into sewers without disinfection, the sewerage and the neighboring soil would contain virulent bacilli for several months afterwards. The observations of MÖLLER¹⁷, who found living tubercle bacilli in the subsoil irrigation system, as well as in radishes grown on the irrigated soil of the sanitarium at Belzig, are also significant.

Since these facts have come to light it has been decided that it is necessary to proceed energetically against the tubercle bacillus, and this must be done either by sterilizing or burning the sputum.

So much for theory ; but what about practice ? If our spitting cups be placed for half an hour in streaming steam at 100 to 104°C. (KIRCHNER¹⁸, HEIM¹⁹, WEBER²⁰, DE LA CAMP²¹) we have to contend with two difficulties, namely, the cracking of a certain number of sputum cups, and the destruction of the rubber stoppers of the pocket-sputum-flasks. At any rate, it is necessary, then, to provide each patient with an enameled metal sputum cup, so marked that each patient uses a separate one and that it is returned to him each time after sterilizing. For the use of smaller establishments there are the Soxhlet-like tin kettles described by HEIM¹⁹, which have trays that can be inserted, or the sterilizers made by Schmidt Brothers in Weimar (DE LA CAMP²¹), but it is doubtful whether they can be properly handled when they are entrusted to the ignorant classes. Large establishments where steam-sterilization must go on upon a large scale require properly trained attendants who can differentiate properly between increase and decrease of heat and other points in the management of the apparatus. Is this always possible ? I am somewhat doubtful, for man is always inclined to weakness and negligence. The disinfector of sputum should not be compared to the disinfector of laundry, who turns his work over to the laundresses, nor to the cook who is strictly responsible afterwards for whatever he does.

If sputum is to be disinfected by another method, namely by boiling (SCHILL and FISCHER³, GRANCHER and GENNES²²) for half an hour, care must be taken to secure the removal of the vapors, the odor of which is extremely unpleasant. In fact, the entire manipulation is disgusting in the extreme. LEYDEN²³ characterizes it as tedious and inconvenient.

Now as regards the burning of sputum. Is the way to the furnace

always straight and uncomplicated? If, for example, as with us in Belzig, the sputum from the individual cups must first be emptied into a common pail, mixed with a solution of mercuric chloride, then with sawdust, and placed in tin cups into the fire, after the latter has been brought to a white heat, how many sources of error are possible (WEBER²⁰).

When the sputum is to be burnt, many authors recommend that in collecting it the fluid media be dispensed with and that the sputum be directly expectorated into sawdust (Achtermann, Kobert, HELLER²⁴) and peat (VON WEISMAYR²⁷). In Alland near Vienna, for example, peat is mixed with the contents of the sputum flasks by attendants in a special washing room, and the flasks are only washed, not disinfected, while the dry mass of sputum and peat is shoveled into the fire.

The preparation styled "antisputol", which has been recently recommended, (GERTLER²⁸) is said to penetrate into the clumps of sputum, but I could not convince myself of that. It consists of one hundred parts of peat, fifteen parts of saturated aqueous solution of copper sulphate, and two per cent. of formalin. When the sputum was expectorated upon the powder contained in the sputum cups, it was not even absorbed, much less removed from sight, and in order to incorporate the sputum with the powder they had to be well mixed. The mass thus obtained was, it is true, fairly coherent and removable from the cups without any appreciable residue.

The combustible (von Schrötter, von Weismayr, Mjöen, Stone, FLÜGGE²⁵) sputum cups, and the incombustible metallic receptacles (ELLIOT⁴⁹) have the advantage that they enable us to avoid this tedious procedure. Although the low price and excellent workmanship of the paper cups made under Flügge's direction are astonishing, yet, I think that the majority of the public have æsthetic objections against them. Sputum is and remains a disgusting affair, and it becomes still more so in a paper receptacle, so my feeling tells me, no matter how water-tight this envelope may be. Sputum is and remains a "nauseating, morbid excretion" which, after it has been rendered as harmless as possible, belongs where all such things belong—into the sewer, where it is removed from sight (MEISSEN²⁹).

In my opinion, the introduction of paper sputum cups would meet with insurmountable difficulties if it were attempted in sanatoria for the wealthier classes.

As we see, the method of sterilization and that of burning are not absolutely without flaws. Here we can also say: *Aliquid semper haeret*,

without going back to the ideas of nihilism. The sterilization of sputum must always be a relative one only, for it must not be forgotten how long a way the sputum has to go from the mouth of the patient before it reaches the receptacle in which it is to be sterilized. We are far from considering the absolute sterilization of sputum in the same light as the surgeon, for example, considers his preparations for an operation, when he has rendered himself sterile, has disinfected the field of operation and has boiled his instruments. Buttersack says aptly: "The attempts at disinfection always appear to me like trying to suppress the waves of the sea. We can no more cover the entire surface of the sea with a layer of oil than we can sterilize the entire continent". And WINTERNITZ³⁰ says: "Even if we had educated the entire human population of the world to the observance of spitting regulations, myriads upon myriads of germs which would be sufficient to infect the entire human race would still escape the sputum cup and the sputum flask."

But we must not take this sad fact too seriously, now that the dread of bacilli, which has been so often spoken of, and which still fills the heads, not only of laymen but of a few physicians, has given room to a more rational and broader view on this subject. Just because the sterilization and combustion of sputum is not a safe and unobjectionable procedure in practice, I do not consider the study of the chemical methods of disinfection as a step backwards into a field that has been exhausted and proved of no value. I do not propose to throw away all the methods of chemical disinfection of the sputum because some have proved unreliable. That would be like "pouring out the child with the bath". It is true, on looking over the observations hitherto published on the subject of chemical disinfection of sputum, one is placed in a dilemma and begins to feel suspicious. For example, the opinions about mercuric chloride, the most powerful disinfectant among the metallic salts, at the same time a very inexpensive chemical, are widely at variance. BEHRING¹ blames its exceedingly poisonous character, and the fact that it precipitates metallic albuminates in the presence of albuminous substances, thus surrounding the bacilli with layers of mercuric albuminate, which is soluble only with great difficulty. "The clumps of sputum which are thrown into a solution of mercuric chloride are quickly surrounded by a dense, leather-like layer through which the diffusion of the disinfectant into the interior of the clump can go on but very slowly, (MEISSEN^{31a}). Schill and Fischer also found a 2-1000 solution of mercuric chloride ineffectual. On the other hand, STEINITZ³² in his experiments with mercuric

chloride and common salt reports that a 1-1000 solution killed tubercle bacilli in fresh sputum in from six to eight days; a 2-1000 solution in from three to five days; a 5-1000 solution in ninety minutes.

Of the aromatic series of organic disinfectants, which, as is well known, have the advantage of not being influenced by the presence of other organic substances, the most important is crude carbolic acid (*cresolum crudum*), but before it can be used it must be rendered soluble. The method of Laplace and Fränkel, i. e., the solution of crude carbolic acid or the crude cresols in sulphuric acid, has been abandoned, since it has been shown that the salts of the cresol-sulphonic acids which are formed with urea, with the ammonia of the excrements, with lime and earthy alkalis, do not possess any disinfectant properties. Pearson's creolin depends upon another method which employs soaps for the solution. When diluted with water this preparation gives a very uncertain and unstable emulsion according to HUEPPE³⁴, and it has been declared as untrustworthy by GERLACH³⁵, on account of the unstable composition of the preparation and the formation of precipitates.

Lysol contains 50 per cent. crude cresol, and has been recommended by numerous authors, particularly by MEISSEN^{31b} as the substance which would probably be used in the future for rendering sputum cups antiseptic. It has the disadvantage, first of a disagreeable odor which disqualifies it in society, and evokes headache and nausea (Leube); second, of imperfect solubility in water and third, of a comparatively high price (about 2 marks per kilogramme). The discouraging results obtained by SPENGLER⁴ with this preparation are in opposition to those of GERLACH³⁵.

Lysoform, a formaldehyde soap preparation, does not have the strong odor of lysol, is less antiseptic, and also insoluble in hard water. It is more expensive than lysol (SYMANSKI³⁶, CRAMER³⁷).

Bacillol, a solution of tar oils in soap (52 per cent. cresol), less expensive than lysol (1 mark per kilogramme), was recommended by CRAMER, of Aix la Chapelle³⁷, in a mixture of from 3 per cent. to 4 per cent. strength for the disinfection of sputum, but also exhibits the disadvantages of a cloudy solution and a disagreeable cresol odor. The same is true of kresol (Raschig) 50 per cent.; of sapocresol (Schweissing) 50 per cent. to 55 per cent.; and of saprol (40 per cent. to 45 per cent. cresol!).

Crude solutol (with 60 per cent. crude cresol) is cresol which has been dissolved in sodium cresolate. It has the advantage of a more per-

fect solubility and low price and is preferred to the other disinfectants by HUEPPE³⁴ and BUTTERSACK².

In the Imperial Sanitary Bureau in Berlin, sputum which had been dried on wooden boards or glass plates was found harmless when dissolved in water and injected intraperitoneally into four guinea-pigs, after the plates had been treated for two minutes with a 2 per cent. solution of crude solutol. On the other hand, solutions of the lysol and cresol of equal strength did not render such sputum innocuous. Like other disinfectants, however, crude solutol is less favorably received by some authors. While HUEPPE³⁴ found that a 10 per cent. solution of crude solutol killed anthrax spores at ordinary temperature in 24 hours, KRÖNIG, PAUL and SCHEURLEN³⁹ did not observe this effect, even when a 2.5 per cent. solution had been allowed to act for four days and a 10 per cent. solution for six days.

Solutol, i. e., a cresol dissolved in sodium cresotinate, is of no value, according to the investigations of SCHUTZ⁴⁰, SCHURMEYER⁴¹ and BUTTERSACK², in the disinfection of sputum.

Of the three isomeric cresols theoretically possible, metacresol seems stronger than paracresol and the latter stronger than orthocresol (HENLE⁴², FRAENKEL³³), while their solubility in water is in inverse proportion to their strength. A 90 per cent. solution of orthocresol free from water is contained in Nördlinger's pure liquified cresol which gives a clear solution in water, but this preparation is unsuited for our purposes on account of its high price.

If we wish to study the value of these agents, which has been so widely discussed, we must first realize the complexity of the medium with which we are working. The infectious material of tuberculous sputa is not a culture nor a test-thread containing spores. Macroscopic examination shows that such sputa can be divided into those in which mucus prevails, and those which are largely purulent in character, and there are transitions between these two extremes. The mucus contains mucin, which is insoluble in the caustic alkalies. The pus contains considerable amounts of serum albumin, globulin, peptone, nuclealbumin, glycogen, small amounts of grape sugar, nuclein, fats, cholesterin, inorganic salts, fatty acids, traces of uric acid and of xanthin bases.

The mucus, *i. e.*, the proteids with the contained air bubbles, is the barrier by which the exciting agents of tuberculosis are surrounded. The germs themselves are also surrounded by resistant envelopes consisting largely of fatty acids and a wax-like mass (ARONSON⁴³) or, according to

other observers, by a chitin-like mass (HELBING⁴⁴). The secret of chemical or rather chemico-physical disinfection of sputum, which has not been in my opinion sufficiently emphasized, lies in breaking these barriers. It is absolutely necessary to disintegrate the sputa ; in a measure to digest them.

If we subject a clump of sputum to the action of a solution of mercuric chloride, lysol, lysoform, bacillol or solutol, we find that the envelope of mucus is scarcely attacked (lysol gives the most favorable results in this respect), and therefore the disinfectant cannot penetrate into the nucleus of the sputum except by slow osmosis.

At Meissen's suggestion therefore, I have been looking for an ally for the disinfectant proper, and found such a companion in sodium hydrate. This agent transforms the albumins and the mucin into soluble sodium albuminates and secures the saponification of the fatty constituents. The result is markedly liquified and disintegrated sputum. The action of the alkali is three-fold. It is a solvent, a direct bactericidal, and finally a mechanical cleansing agent.

BEHRING¹ and REINICKÉ⁴⁵ declare that the disinfecting powers of forty different varieties of soaps depend chiefly upon their contents of alkali. Soaps containing mercuric chloride, tar or carbolic acid do not equal ordinary soft soap ("green soap") in bactericidal power.

According to BEHRING¹ an alkalinity equivalent to 60 c. c. of normal acid per litre and produced by sodium or potassium hydrate or by an alkaline carbonate, kills the bacilli of typhoid fever, cholera, and anthrax in two hours. The minimum sufficient to kill anthrax, diphtheria and cholera bacilli, according to Behring is an alkaliescence equivalent to 30 c. c. of normal acid per litre, for typhoid and glanders bacilli.

FÖRSTER⁴⁶ also experimented with sodium hydrate (1 per cent.) and found that after an hour's exposure and positively after six hours, it killed the germs of chicken-cholera, diphtheria, typhoid fever, as well as staphylococci. KRÖNIG and PAUL³⁸ showed that a 1.4 per cent. potassium hydrate and a 1 per cent. solution of sodium hydrate can kill the staphylococcus pyogenes aureus, in ten minutes, and that a 5.6 per cent. solution of potassium hydrate and a 4 per cent. solution of sodium hydrate can kill anthrax spores in eighteen hours.

The two last named investigators base their researches upon the theory advanced by Arrhenius, namely, that of the electrolytic dissociation according to which sodium hydroxide in watery solution splits into sodium-ion, Na, and hydroxyl-ion, O.H. This dissociation brings about

the disinfectant property of the alkali and this property is proportional to the concentration of the hydroxyl-ions contained in the solution, *i. e.*, to the degree of electrolytic dissociation. It is still to be settled how the solution of sodium hydrate acts upon the bacteria, whether by destroying the cell wall and protoplasm, or simply by virtue of a chemical change (the abstraction of water), the cell wall remaining intact.

I shall return to the cleansing properties of sodium hydrate later on. It remained for me to determine how the disinfectant should be combined with the sodium hydrate, and I was ready for the practical part of my investigations. The following requirements had to be complied with :

The compound had to be, in the first place, efficient and inexpensive, convenient, easy to use even for the uneducated (without the necessity of mixing or shaking), soluble in ordinary cold tap-water, and in so far as possible had to have an agreeable odor and be harmless, *i. e.*, not caustic and not poisonous. A five or ten per cent. solution of lysol, a two per cent. solution of lysoform, and kresol-Raschig 0.5 per cent., in themselves give cloudy solutions in ordinary water, and the cloudiness is still further increased upon the addition of sodium hydrate. Bacillol, 5 per cent., is also not perfectly clear, but sodium hydrate does not increase its turbidity while its odor is very disagreeable. Schweissinger's sapocresol, 4 per cent., is quite readily soluble in water, and with sodium hydrate also gives a whitish cloudy solution and a penetrating odor of soap. Aqua cresolica, too, is disagreeable on account of its cresol odor, although it gives a clear solution in water which is not clouded by alkalies. Under these circumstances solutol, which has been highly recommended, or similar preparations which were prepared especially for Hohenhonnef under my directions by two chemical factories, appeared to be the most available disinfectants. A preparation resembling crude solutol has been thoroughly tested some time ago by BUTTERSACK². This author found by inoculations in fourteen guinea pigs that fresh sputum to which from 6.6 per cent. to 10 per cent. of purified cresol in purified sodium cresol-carbonate or of crude cresol in crude sodium cresotinate were added in excess lost its infectiousness after being stirred from time to time for twelve, ten or even six hours. Crude solutol is not soluble with a clear solution in ordinary water (5-100), but gives a brown cloudy liquid in which a finely flocculent dark precipitate is suspended. The latter increases on the addition of sodium hydrate, and consists of hydrocarbons, resins, naphthalin, carbonates. The alkali also transforms a portion of the cresol into cresol-alkali. In pure solutol, however, the precipitate spoken

of is very slight and a 5 per cent. solution of this substance appears light-brown and slightly opalescent. On the addition of 1 per cent. of sodium hydrate even this slight precipitate disappears completely. Solutol "Extra Quality" and another preparation, Kresolpräparat M. P., are distinguished by their much less pronounced odor and perfectly clear watery solutions, from 3 per cent. to 5 per cent. Potassium hydrate, by the way, does not act differently from sodium hydrate, but seems to be less valuable on account of its higher price.

I therefore prepared alkaline solutol or cresol solutions in various proportions, so that they contained from 2.5 per cent. to 3 per cent. of pure cresol and 3 per cent. of sodium hydroxide, taking into consideration the fact that my preparations contained from 50 per cent. to 60 per cent. of cresol. The dissolving properties of these solutions were very marked and comparable to a digestive process, when these compounds were placed in the sputum cups at Hohenhonnet. Solutol alone, in 10 per cent. solutions attacks the clumps of sputum macroscopically, but only so that fairly dense and coarsely divided particles are left which can be further divided by shaking. The whole fluid is then markedly opaque. If alkali be added, however, this cloudiness is absent. If, therefore, a tentold volume of a 5 per cent. cresol and 3 per cent. sodium hydrate solution be added to some typical clumps of tuberculous sputum, they will be so altered in form that after two or three hours they can scarcely be found in the liquid. The solution remains clear and transparent, if there be no admixture of blood, and in place of the sputum there are more or less transparent clouds. It is true, however, that not all sputa act in this manner, and the effect depends upon their quantity and composition. I must emphasize at once that a large amount of the disinfectant must be added in order to secure the digestion of the sputum—for example a tentfold volume. This corresponds to the experiments of SCHILL and FISCHER³, made under Koch's direction, according to which an eight to twelvefold amount must be added in order to render sputum innocuous by means of 3 per cent. carbolic acid, saturated water, analine solution or absolute alcohol.

In the chemico-physical method of disinfecting sputum one must bear in mind, also that nothing can be accomplished with a small amount acting for a short time, but that only the right amount and sufficient length of exposure are effective. I agree thoroughly with CRAMER, of Aix la Chapelle³⁷, who recommends an exposure of from twelve to twenty-four hours, during which time the solution is either set aside in the

sputum cup, or in a collecting receptacle which can be easily provided. The latter could be very usefully connected with a water closet or running water.

Under the influence of our solution the mucus, the most important constituent of sputum, becomes transparent, the pus cells disappear from it or are reduced to a minimum. When a more complete solution becomes impossible on account of saturation, it forms a gelatinous mass which becomes noticeable through its coherence in shaking or pouring, and which is singularly mobile, permitting an easy and complete removal by pouring out without leaving any adherent traces in the vessel.

I do not claim that the mucus entirely disappears, but at all events it grows less and is changed by the action of the solution to such consistency that it may be poured out neatly without any appreciable residue of mucus. This ease in pouring out the sputum, I think, constitutes a distinct advance in our method. Both professional and lay opinions agree that the great difficulty in the disinfection of sputum receptacles lies in their cleansing, which is, as a rule, done more or less incompletely and unsatisfactorily (FLUEGGE²⁵, HEIM¹⁹). If the disinfectant is added to the sputum at the moment of cleaning the receptacle, as has been recommended, its value is, to say the least, problematic, and the patient or nurse does not always take the necessary time and care which is needed for a thorough cleansing. Under such conditions it is very apt to happen that the exterior of the cup may be soiled, and hurriedly wiped with cloths the further fate of which, it is not always possible to follow.

With our method, however, the sputum undergoes a thorough preparatory treatment from the moment that it leaves the patient's mouth. The disinfection begins as JAEGER⁴⁷ has pointed out, at the bedside, and the sputum is prepared for a convenient and harmless removal to the sewer.

Another source of error in the disinfection of sputum is to be avoided in using this method, namely the sinking of sputum which contains a great deal of pus to the bottom of the vessel. When such a sputum has once reached the bottom, the surrounding solution is quickly saturated, and diffusion can go on further only very slowly. Hence we must see that the sputum clumps do not sink rapidly. For this purpose I tried two ways. First I made the solution more glutinous by the addition of starch, but the action of the alkali was considerably diminished thereby, the solution became less transparent and less easily poured out. Another way is to rendered the specific gravity of the solution higher than that of the

sputum by the addition of an alkaline salt, although this produces a certain amount of coagulation on the part of the mucin. It has not been settled as yet to what degree the disinfecting effect is increased by the addition of an inorganic salt, such as has been suggested by KRÖNIG, PAUL,³⁸ SCHEURLEN³⁹, BECKMANN⁴⁸, in connection with phenol tests. At any rate, the effect of the disinfecting fluid which has been so rendered heavier cannot be denied. Clumps of sputum which lay at the bottom of sputum cups now float at the top, and become distorted into fantastic shapes, or rolled up like cylinders gradually sinking into the interior of the solution, and finally sink to the bottom after having been thoroughly digested on their way. When examined then, they appear as a finely granular amorphous sediment. I could not demonstrate the presence of tubercle bacilli in the latter by Fraenkel-Gabbett's method of staining.

A further and still more important point in the practice of disinfection, is the removal of the very unpleasant cresol odor. I have experimented with a variety of substances, among others with extract of pine needles, which however produces a less desirable dark coloring, and also with tincture of benzoin, and with the salts remaining after the manufacture of cologne water. The two last named substances give a precipitate, and the same is true of essence of Waldmeister nitro-benzol, which is not soluble but miscible with the solution, is a very energetic deodorant, but the odor of which is too harsh, too penetrating, and occasionally in sensitive patients, produces a tendency to vomiting. Ethereal oils cannot be considered on account of their insolubility, but as a matter of fact, the addition of a few drops of oil of lavender produced only a very transient slight cloudiness and a very lasting perfume which covered the cresol odor.

In this manner I have obtained a combination the exact formula for which I do not publish as yet, because before I have finally fixed it, it must undergo certain further tests and its manufacture must be arranged for with chemical factories. The results which I have obtained with inoculations into guinea pigs are perfectly satisfactory. For obvious reasons, the technique of inoculations must be perfect in all its details and must include a very thorough washing of the diluted residue of sputum; otherwise the cresol and the alkali introduced into the body with the sputum may induce a fatal peritonitis, such as I have noted in some instances in my first experiments. I began my experiments by exposing two or three clumps of sputum with a total weight of about 5 grammes to about ten times the quantity of disinfectant, without mixing

or shaking. After a certain time (from six to twenty-four hours) the disinfecting solution was exchanged for sterile water and the sputum was washed upon a sterile filter with a considerable quantity of sterilized water. Then, according to the age of the animals, from one-third to one syringe-ful was injected intraperitoneally; the animal was first isolated and placed under the most favorable hygienic conditions possible. I inoculated thirty-two guinea pigs in this manner, and the results may be gleaned from the following table:

TABLE OF EXPERIMENTS.

| NO. OF GUINEA PIGS | DISINFECTANT AMOUNT IN 100 gm. WATER. | HOURS DURATION OF EXPOSURE | AUTOPSY AFTER HOW MANY DAYS? | WHETHER FOUND TUBERCULOUS, 0=NO †=YES. | REMARKS | |
|--------------------|--|----------------------------|----------------------------------|---|--|---------------------------------|
| 4 Control Animals. | | | 13, 17, 30, 35 | † † † † | | |
| 1 | Crude Solutol Residue* | 12 | 20 | † | *Precipitate from the crude solutol solution mixed with Na O H. | |
| 1 | Lysol | 10 | 67 | † | Gave birth to a litter in the meanwhile. | |
| 1 | Lysoform | 2 | 71 | † | | |
| 5 | Crude Solutol Na OH | 2 0.57 | 3—6 | 2, 77, 76, 82, 71 | † † † † † | First case : Acute peritonitis. |
| 1 | Na OH | 0.57 | 6 | 63 | † | |
| 3 | Pure Solutol | 3 | 10 | 42, 42, 27 | † † † | |
| 8 | Steam at 104° | ½ | 42, 43, 43, 43 44, 42, 42, 43 | o o o o o ? o ? o o | Two animals gave birth to litters ; In 2 there were suspicious small infiltrates in the lungs. Microscopically : A mass of small lymphatic cells of inflammatory character . | |
| 1 | Crude Solutol | 5 | 24 | 77 | o | |
| 4 | Solutol, ex. quality, Na OH Alkaline Salt | 5 3 5 | 12—24 | 44, 43, 43, 43 | o o o o | - |
| 1 | Agu. Cresol Na OH Alkaline Salt | 30 3 5 | 24 | 27 | o | |
| 1 | Kresol preparat. M. P. Na OH Alkaline Salt | 3 3 10 | 24 | 27 | o | |
| 1 | Solutol H Na OH Alkaline Salt | 3 2 10 | 24 | 27 | o | |

Further investigations are still wanting, but in view of the tables which we exhibited in the museum of the last International Tuberculosis

Congress in Berlin, I desire here also to state my position in this matter.

So far as I can judge at present, the solution we used is, in contrast to others, perfectly clear, at the same time inexpensive, conveniently handled, not dangerous, has an agreeable odor, and even removes putrid odors (fœtid processes in the lungs), and need not be renewed daily in sputum cups that are but little used, for example in public places, inasmuch as it removes the sputa from sight. It dissolves, and digests, as I call it, the clumps of sputum and may be poured out of the receptacle neatly, without any residue of mucus. "It can be employed wherever the appliances for sterilizing or burning sputum are lacking or cannot be provided, and it is there that we find the most fruitful sources of tuberculous sputum and therefore of the spread of tuberculosis"—(Meissen, *Tageblatt der Internationalen Tuberkulosekonferenz*, Berlin, 1903, p. 55).

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REVIEW OF CURRENT LITERATURE.

TUBERCULOUS INFECTION IN CHILDHOOD AND ITS PREVENTION

A thorough knowledge of the various modes of infection is necessary in order to be able to formulate methods for the prevention of tuberculosis. The frequency of tuberculosis in childhood may be judged from the fact that Bollinger, of Munich, found tuberculosis in 43.6 per cent. in 500 cadavers of children; of these 13.6 per cent. had latent tuberculosis, and in 30 per cent. the tuberculosis was the cause of death. As regards the frequency of tuberculosis in children of different ages, it may be stated that Comby performed autopsies on 72 children under the age of three months without finding any cases of the disease, but in 13 children between the ages of three and six months there were four (17.54%) with tuberculosis. Of 57 children from six to twelve months old 13 (22.8%) were tuberculous, and of 18 children between one and two years old 38% were affected. The mortality is said to be highest at the end of the first year and during the second year. In a study of the factors favoring tuberculous infection in children Dr. Kornel Preisich and Dr. Aladár Schütz, of Budapest, (*Zeitschrift für Tuberkulose und Heilstättenwesen*, Vol. 3, No. 6, October, 1902, page 470,) who quote the above statistics, advocate a series of preventive measures whereby the frequency of this disease in childhood may be reduced.

The authors do not believe that the frequency of the disease in children can be attributed to a greater susceptibility of the child. The fact that in children tuberculosis often remains local and often is cured spontaneously shows rather that the child is more resistant than the adult. Hereditary tuberculosis is a rare occurrence and in the majority of cases tuberculosis is acquired. In the first year the child is exposed almost exclusively to the danger of direct infection from persons who are in close contact with it. In this way infants may inhale and swallow large numbers of tubercle bacilli, and among the lower classes especially there are many bad and injurious habits which favor infection in nurslings. For example, the chewing of food to be taken by the child, tasting or blowing upon the foods, etc., may be mentioned. When it reaches the second year the child begins to play on the floor and to stir up clouds of dust which it inhales. Its fingers are moistened with saliva, and it touches everything, immediately carrying the object or the fingers to the mouth.

The crusts of bread, bones, etc., which are given to these children to keep them quiet also favor infection. Tuberculosis is a disease of dirt and the dirty nails of these children are a great danger. The authors found in 66 children from six months to two years of age, 14 (21.2%) with tubercle bacilli in the dirt of the nails. These investigations were made in the winter at a season when the children are constantly in doors and when the dirt under the nail is practically equivalent to the dust in the room. The children selected for these examinations belonged to families in which there were no members affected with tuberculosis. The authors call attention to the frequency of tuberculosis of the bones and lymph nodes in children, and to the fact that these patients are often neglected and not given the proper early hospital care, but are allowed to become cripples. In children between the ages of two and six it is also the dust of the rooms that is the most common medium of infection. But in addition to this, there are the various articles of food, such as milk, and butter, which may be infected and may transmit infection. The authors do not think that there is much danger of transmission through milk in nurslings, for that is almost always boiled before the child gets it. The presence of tuberculous foci in the bronchial glands is not necessarily a proof of infection through the respiration any more than the presence of tuberculosis in the intestines is a proof of infection through swallowing. As regards Koch's statement of the innocence of bovine tuberculosis in man, the authors advise that no change be made in the precautions taken with the food of children until the theory advanced by Koch is more positively demonstrated.

In older children the danger of infection is found in the schools and later on in the workshops. The danger is less in boys than in girls, for according to Prussian statistics the mortality from tuberculosis among girls from ten to fifteen years of age is twice as great as among boys of the same age.

The methods of preventing tuberculosis among children must be based on a knowledge of the modes of infection just detailed. A mother suffering from "open" tuberculosis, should not nurse her infant, and should be forbidden all contact with the child. In most cases this will be secured by strict orders to the mother, but if needful the child must be given into the care of relatives or to an institution. It is less difficult to forbid intercourse with a tuberculous father or other member of the family. The marriage of tuberculous individuals should not be forbidden, as tuberculosis is not a hereditary disease, but it should be the duty of society to

preserve the health of a child that is born healthy. Experiments in isolation of the offspring of tuberculous animals have been successful and there is no reason why children of tuberculous parents should not remain healthy if isolated in institutions.

In order to avoid as much as possible the danger of infection through dust in the room, disinfection must be undertaken when a person dies of tuberculosis or when a person with tuberculosis changes his residence. For this purpose it is necessary that every case of tuberculosis be reported to the health authorities. Ignorance and poverty are responsible for a great many cases of infection. The hygiene of the tenements in the large cities should be thoroughly reformed and the dark and narrow quarters in which the poor live should be done away with. The public should be educated to fight against tuberculosis by the establishment of societies for that purpose. More attention should be paid to the prevention of disease in the teaching of hygiene in schools, and children should be taught from early age that spitting on the floor is forbidden. Instructions should be distributed to parents telling them how best to take care of their children. Such instructions should be given at the birth of every child and also at the time of sending a child to school. Care must be taken that these instructions reach every family in which there is some form of tuberculosis. Children should be allowed to play in the open air as much as possible as infection most often occurs in children that are kept at home. In the cities there should be as many open spaces and parks as possible. Play-schools and nurseries should be established for children of working people who cannot take care of them in the open air, and such children should be allowed to play in open play grounds and should be given their food during the hours in which they are kept at play. Tuberculous children should be excluded from these institutions. More vacation-colonies and more opportunities for exercise in the open air should be given to children of school age.

Adults with tuberculosis, while they are able to work, should be enjoined to take care of their sputum, but if they become more seriously ill and can no longer work they should be removed to hospitals. Patients with "open" bony or glandular tuberculosis should also be isolated, for they can be cured comparatively easily in hospitals, whereas at home they may infect everyone that comes in close contact with them. Special hospitals for the treatment of tuberculosis of the bones and other forms of surgical tuberculosis in children should be established, and sanatoria for such children should be built by the seaside.

Precautions should be taken to prevent the transmission of tuberculosis through the food. Infants artificially fed are more susceptible to infection, and all infants should be nursed if possible, but not by tuberculous mothers or tuberculous wet-nurses. Milk should be sterilized before it is given to children, as the possibility of infection through milk is not excluded. Butter from cows that have passed the tuberculin test should be used exclusively, and meat should always be roasted or broiled; never given raw. Food which is given to children should be free from all dust and dirt, and should not be blown upon, nor otherwise contaminated.

In conclusion the authors point out that the measures at present taken against the spread of tuberculosis for the most part are *directed towards protecting adults*. *Very little has as yet been done to protect children against this disease*. The root of the evil must be attacked, and this root is tuberculosis in children; for many authorities agree that most tuberculous individuals have been infected in childhood. The prevention of tuberculosis in children would prove actually less expensive than the erection of a sufficient number of sanatoria for adults.

SANITARY MEASURES FOR THE PREVENTION OF TUBERCULOSIS IN NEW YORK CITY AND THEIR RESULTS.

The problem of combating the spread of tuberculosis in New York has been, for many years, in charge of Dr. Herman M. Biggs, and his summary (*Journal of the Amer. Med. Assn.*, December 27, 1902) of the results obtained by the various measures which have been adopted by that municipality in this combat may therefore be regarded as authoritative. The work of preventing the spread of tuberculosis in New York may be said to date from 1888, when Dr. Biggs, in a communication to the Board of Health of that city, urged the need of recognizing tuberculosis as a communicable disease. In 1889 a circular was issued to the public, and widely distributed in the tenement-house districts, setting forth the nature of the disease and the precautions needed to prevent its spread. The question then remained latent until 1893, when Dr. Biggs again urged the limited control of tuberculosis. In compliance with his recommendations, the Board adopted resolutions requesting all physicians to report cases of tuberculosis occurring in their private practices, providing for the examination of the sputa of patients free of charge, and for the visitation and instruction of patients not under the care of private physicians, residing in tenement houses, private houses, or hotels. All premises,

after they had been vacated by consumptives either by death or removal, were required to be disinfected by the Board of Health. New York was the first city to establish municipal diagnostic laboratories for the examination of sputa. In 1897 the legal force of the measures already in operation was strengthened by the adoption of a resolution amending the Sanitary Code of the City of New York, whereby consumption was declared an "infectious and communicable disease, dangerous to the public health," and whereby physicians and others were required to report to the department all cases of the disease coming under their observation. Such reports must be made in writing within one week of the time when the diagnosis has been made. In addition, all persons suffering from the disease, and all persons in attendance upon patients suffering from consumption, were required to observe all the rules and precautions against its spread prescribed by the Board of Health. Tuberculosis was declared to be communicable, not contagious, in contradistinction to such diseases as smallpox, scarlet fever, diphtheria, etc., which the public now knows to be contagious. At first medical societies of the City of New York protested against what they thought to be an unwarranted assumption of power on the part of the Board, but of late there has been acquiescence and approval on all sides. Physicians have not been prosecuted for not reporting cases, but if they give a death certificate with tuberculosis as cause of death, and if the case had not been reported they get a letter from the Board calling attention to the provisions of the Sanitary Code and asking why the case had not been previously reported. In this manner registrations of cases become more and more complete as time goes on.

In 1894, when the registration was begun, there were 4,263 cases reported. In 1897, there were 9,572 cases reported, and in 1901, 17,588 cases (including 4,191 duplicates). During the period since 1894 nearly 90,000 cases have been reported. The number of specimens of sputum sent for examination to the laboratories of the department was 511 in 1894 and 6,744 in 1901. The reports of cases are kept on file on card indices, arranged by names and streets. The cases are also plotted on specially drawn maps showing every lot in the city, and bearing a dot with the date of the report, date of death, etc., of each case. When patients are not under the care of private physicians, they are visited at their homes by inspectors who give them instructions as to hygiene, and as to the mode of preventing the communication of their disease, and also instruct the friends as to how to take care of the sputum, etc. When a patient dies or moves away, an inspector visits the premises, and writes

out recommendations regarding the renovation of the rooms. As a rule kalsomining of the ceiling and walls, or washing with a solution of soda (one-half pound to three gal. of hot water); washing and repapering of paper walls, scrubbing of woodwork with soda solution, are the measures recommended. The department then issues an order to the landlord to comply with these recommendations within ten days, and the sanitary police sees that the order is executed. The patient's effects and carpets, bedding, etc., are disinfected free of charge at the city disinfecting plant, but this is not always feasible, for the effects are often removed, washed or otherwise disposed of soon after the patient's death. Many difficulties have been met with in the prosecution of this work, chiefly through the unwillingness of private physicians to report cases. Some give death certificates of pneumonia or chronic bronchitis to conceal cases of tuberculosis. The department now looks up every death reported in persons over fifteen years of age, to see whether there has ever been a report of tuberculosis in the case.

Dr. Biggs points with satisfaction to the results attained by these measures. The death rate from tuberculous diseases in New York has been reduced since 1886 from 4.42 to 2.89 in 1901.

THE TUBERCULOUS PATIENT IN SOCIETY.

Julius Friedländer, of Berlin, (*Tuberculosis*, Vol. 1, No. 10, p. 235, December, 1902,) writes of the position of the tuberculous patient in society according to modern views of infection and prophylaxis. The periods of confinement in sanatoria or in "closed" health resorts are always limited, and although it is desirable to defer the patient's discharge until he is completely cured, this is not always possible. It is not necessary here to consider the indications for the discharge of a tuberculous patient from a sanatorium, but it may be said that the patient's education should have been completed as regards his future mode of life, before he is allowed to go out of the institution. This education consists in systematic drill in the methods of preventing infection from spreading from the patient to others.

If a patient who has been thus trained enters into society, it is very sad if he meets with general distrust and fear at every step. It is only when he pretends to be healthy that no one evades him and no one annoys him. For this reason, it frequently happens that patients will rather swallow

their sputum or will expectorate anywhere secretly rather than expose themselves to remarks by using the sputum flask. This hypocrisy which entails just as great a danger of contagion for the patient as for the persons surrounding him, is fostered by the public who sees in the sputum-cup not a means of preventing contagion but a betrayal of the presence of a patient with infectious disease. Plithisiophobia has reached a stage among the public, which threatens both the patient and those who come in contact with him. In large commercial offices the chiefs often prevent an employee who has betrayed his disease by the use of a cup from reëntering the establishment after he has improved. The head of a large banking house gave a leave of absence of six weeks, together with a notice of discharge to a young man with tuberculosis, because he feared that the presence of this employee would prove dangerous to himself and to the other persons employed by the firm.

The public must gain the conviction that a patient who has been in a sanatorium is capable of preventing the spread of his disease, even though he still coughs and expectorates. The well-disciplined patient with pulmonary disease can demand that he be received as an equal among equals everywhere, and not be treated as an outcast whose misfortune has become an eternal curse. This is not only a demand of humanity, but also of prudence.

The danger of infection is only increased when the tuberculous patient is compelled to hide his disease and to make but a very imperfect use of the measures which have passed, so to speak, into his very flesh and blood. It may be noted that in the so-called "open" health resorts, as a rule, there is no provision for the special needs of the tuberculous patient. His presence is merely tolerated, for if special measures were adopted for his comfort, the other, non-tuberculous guests would object. So it happens that the consumptive at these resorts has no place where he can take the rest cure or the open air cure, except, perhaps, some hidden verandah which is provided with a reclining chair or two. He is obliged to do as the other guests do; to sit on the benches of the promenade or in the park; to inhale the dust and cigarette smoke, and to mingle with the crush of people, and to take part in the mountain walks, etc. It is impossible for the consumptive in these places to get the requisite rest, for not rest, but recreation, is the main object at the watering-places. It is very rarely that a room or a bed which has been occupied by a consumptive is disinfected at these resorts, for the simple reason that in all probability he did not announce the fact that he had the disease, in order

to be safe from the danger of being "put out"; hence these health resorts become breeding-places of tuberculosis, and should never be recommended to consumptives.

The same is true of the resorts of the north (of Europe). Although Nervi and San Remo are considered the most important health resorts for consumptives, it is astonishing that there are still patients who care to go there in order to be cured of their disease. Except in one hotel, there is no asylum for the consumptives in Nervi. Large and small hotels vie with one another to make the life of the consumptive guests miserable, so as to get rid of them, inasmuch as they injure their other business. At the beginning of the season, when the resort is not yet crowded, the hotel keepers receive the consumptive with smiling faces and with every effort at rendering them comfortable. They turn deaf ears to the cough which they hear and close their eyes to the expectoration. But when the height of the season approaches, and the hotels become crowded with healthy patrons, then the hotel keepers become cold, inattentive, and irritable towards their tuberculous guests, and try to get rid of them by gentle hints or even by brutal frankness. The consumptives in these hotels are compelled to make a secret of their disease, and to bear all the privations which are imposed upon them by the landlord in his own commercial interest, simply because they have faith in the healing virtues of the climate. It happens often that patients who cough much or who are very markedly emaciated are compelled to leave the hotel, and then they wander from one hotel to another and during the height of the season they can find lodgings only with great difficulty. If the mode of life of the consumptives at these resorts be observed, it becomes apparent that all the hygienic and dietetic rules of treatment have been forgotten. It must be asked, what benefit can a patient get from a sojourn at one of these watering places? He is losing time and money, and is exhausted physically and mentally, and all this, because society considers the consumptive too readily as an outcast.

There is no doubt that ways and means must be found to examine the various health resorts as to their availability for patients who have been discharged from sanatoria. No patient should be sent to a free health resort unless a guarantee can be obtained that he will be well cared for, and provided with all the comforts he needs. As matters are at present, the sojourn at a health resort is usually a source of infection, and injurious to the patients who go there, instead of being beneficial. Some way must be found to separate the consumptives from the other guests at the

free watering places. But it is very important that in all strata of society the conviction may be gained that a well disciplined consumptive is not a source of danger for his surroundings.

THE DESTRUCTION OF TUBERCLE BACILLI IN MILK HEATED TO SIXTY DEGREES CENTIGRADE.

W. Hesse (*Zeitschrift für Hygiene und Infektionskrankheiten*, Vol. 42, No. 1, January 13, 1903, p. 175) considers the important question as to what is the lowest temperature at which tubercle bacilli may be destroyed in milk. The lower the temperature of sterilization, the less does the chemical and physical constitution of milk suffer by the process. This question has been thoroughly studied some time ago by Theobald Smith, of Boston, (*Jour. Exper. Med.*, Vol. IV, No. 2, 1899,) who showed that tubercle bacilli die within from fifteen to twenty minutes in milk that has been heated to 60°C. The proper method for securing this sterilization is the immersion of the milk into vessels with water at 60°C, or the pasteurization of milk in closed and entirely filled receptacles at 60°C, the time mentioned above being measured from the time when the milk reaches 60°. In accordance with the data given by Smith, the author caused the entire output of milk of a large dairy in Dresden to be pasteurized at 60°, the heating being done in special containers, after the milk had passed through silicate filters. The author tested the value of this method in the following manner: He mixed some sterilized milk with some bouillon culture of the tubercle bacillus; the tubes in which the mixture was made were then drawn out in the flame, and so sealed. Some were kept as controls, while others were immersed into vats of milk which was to be pasteurized at 60°. After twenty minutes they were removed and cooled in cold water. The contents of the pasteurized sealed tubes was injected into a series of guinea-pigs. The animals which had received injections of milk that had not been pasteurized showed a generalized tuberculosis of a most pronounced type. Those that had received milk that had been pasteurized at 60° showed no tuberculous lesions. Those that had been given injections of milk that had been heated only to 57° showed tuberculous lesions, but less extensive than the controls, and those that had been injected with milk containing tubercle bacilli that had been sterilized at 58° showed less extensive lesions than the ones injected with milk pasteurized at 57°.

The statements of Theobald Smith are therefore confirmed by the

experiments of the present author. Some authors, such as Levy and Bruns, who declare that a temperature of 65°C. for fifteen or twenty minutes is needed to destroy tubercle bacilli in milk, evidently were unacquainted with the work of Smith, and did not consider the possibility of lower temperatures. It is necessary to keep the milk in motion by a stirring appliance in order to avoid cooling of the upper layers and the formation of a film, which may prevent the destruction of some of the tubercle bacilli at the temperature given by Smith. Other experiments previously published by the authors showed that the temperature of 60°C. recommended by Smith also destroyed, in from fifteen to twenty minutes, the cholera bacillus, the typhoid bacillus, the bacillus coli communis, the diphtheria bacillus, two different varieties of streptococci, three different varieties of staphylococcus aureus, and the staphylococcus albus.

THE CLASSIFICATION OF ADENOPATHIES (ENLARGED GLANDS).

R. J. Pauchitchivoi, of Staraya-Roussa, (*Revue de la Tuberculose*, April 1903, Vol. X, No. 1, p. 13) studied the question as to whether all adenopathies are of a tuberculous nature, or whether the existence of scrofulous swollen glands should also be admitted. At present the swollen glands so frequently met with in children and in adults, especially among Russian soldiers, are regarded as rather of a tuberculous than of a scrofulous character. For the purpose of solving this question, the author studied minutely a series of enlarged glands in the military hospital of Staraya-Roussa. The histories of all soldiers examined were taken, the physical examinations were recorded, the urine and the blood were examined. Glands were removed from about forty soldiers. Some of them were succulent of a violaceous color, on section; others were hard, firm, and presented a greyish surface on section. On microscopical examination, twenty-four cases had ganglia, covered on their external surface with grey or yellow tubercles, the volume of which was about that of a millet seed or poppy seed. On section purulent masses of caseation were detected, and these contained the bacillus of Koch. In fourteen cases the lymph-nodes were simply enlarged in size, their external surface was smooth, and on section only suppurating foci were found. Microscopical examination showed no tubercle bacilli. In three cases incision demonstrated that we had to deal with periadenitis, with supuration of the entire glandular tissue. These ganglia were not exam-

ined histologically. The author found that the small glands, from the size of a hickory nut to that of a walnut, presented a number of scattered greyish tubercles on their surfaces and on section showed suppurating foci and a thick sanguinolent mass. They contained tubercle bacilli.

From 1900 to 1902 the author examined sixty-two cases of adenitis, of which he found thirty-two clearly tuberculous and twenty-five scrofulous. Hence the current theory that the majority of the enlarged glands met with are tuberculous is correct. Yet it must be admitted that the term scrofula should be kept out of pathological nomenclature, until we have proofs permitting a denial of its identity with tuberculosis.

THE HEART IN TUBERCULOSIS.

Bouchard and Balthazard (*Revue de la Tuberculose*, Vol. X, No. 1, April 1903, p. 1) studied the question as to the possible existence of differences in the dimensions of the hearts of normal and those of tuberculous individuals. There is an idea current that the hearts of persons who are predisposed to tuberculosis are small in size. Percussion does not offer sufficiently accurate data for this investigation, and the authors had recourse to radiography. Guilleminot's method was used, which permitted a tracing of the heart to be outlined on the fluorescent screen. When X-rays are projected from a single source upon a fluorescent screen they give a conical projection of the image of the dense objects intervening between bulb and screen, so that the dimensions of the objects upon the screen are enlarged. Guilleminot, in order to obviate this inconvenience, has devised a movable bulb, which enables one to determine the orthogonal projection of the object. The bulb bears a window of crossed wire placed in such a manner that the threads cross perpendicularly to the plane of the screen. The bulb being movable in a plane parallel to that of the screen, the rays which are perpendicular to the window of crossed wires will always be normal for the plane of the screen. The various points of the contour of the heart are separately determined and marked on the screen (with a skin pencil) by moving the bulb so that it throws the perpendicular rays through the desired point upon the screen. When enough points have thus been marked, the contour of the heart is mapped out by connecting these points. The curve thus obtained is transferred by means of tracing paper to a sheet of paper, and its area is quickly calculated by Amsler's planimeter. Thus the value of S , the area of the projection of the heart, is obtained. As the size of the heart must vary

normally with the size of the patient, with the size of his thorax and with the weight of the person, the authors have devised the following coefficients :

$$\frac{S}{H} ; \frac{S}{T} ; \frac{S}{P}$$

The first is the relation of S to the height of the body, the second of S to the frontal section of the thorax, and the third of S to the weight of the body. The frontal section of the thorax is obtained by measuring on the radiographic screen the distance between the sternal notch and the diaphragm, and multiplying this by the width of the thorax, also measured in the same manner, at the level of the heart apex. Another standard considered was A_n which represents the amount of fixed albumin before emaciation, i. e., the amount of fixed albumin which a person of the same height, the same complexion, and the same musculature (estimated according to Bouchard's method by the size of the tendons) would have in normal condition. A large number of observations were made by the authors. In concluding as to the size of the heart in tuberculosis they say that there are two classes of consumptives. In the first category are those who, not being predisposed to the disease previously, have contracted it by accident ; in the second category are classed the predisposed persons. In the first class, the heart was of normal size in predisposed persons, with latent tuberculosis, the heart was small in comparison with that of persons of their size, etc., the value of $\frac{S}{A_n}$ being on the average 0.5 less than the normal ; in other words the predisposed persons had 0.5 square centimetres less heart area allotted to them per kilogramme of "fixed albumin." In a man having 10 kilogrammes of fixed albumin this would mean a difference of 5 square centimetres of heart area. In the third stage of tuberculosis the dilatation of the heart raises the value of the coefficient $\frac{S}{A_n}$ the value of which averages 9.83 instead of 9.45 which is normal. The dilatation is indicated by a difference (increase) of about 10 square cm. of the area of the heart as compared to the heart of tuberculous persons in the first two stages. This dilatation is much more pronounced when there is a complicating pneumothorax. In other chronic diseases the small size of the heart mentioned by the authors as existing in tuberculosis is not noted.

The value of A_n was calculated by Bouchard's method. See Bouchard, *Traité de Pathologie Générale*, Vol. III.

ON THE EARLY DIAGNOSIS OF TUBERCULOSIS OF THE LUNGS.

C. Krämer, of the Böblingen Sanatorium (*Therapeutische Monatshefte*, January 1903, Vol. 17, No. 1, p. 41), says, in speaking of the early diagnosis of pulmonary tuberculosis: "The earliest diagnosis of pulmonary tuberculosis is that which is made at the very outset of the affection in the lung. I think that the pulmonary lesions of this disease are almost always metastases of tuberculosis elsewhere, e. g., in the glands, where the process had for a long time lain dormant, where it originates more often than is supposed, through heredity." Krämer is opposed to the generally accepted idea that pulmonary tuberculosis originates in the majority of instances through inhalation. The small proportion of cases (about ten per cent.) in which both husband and wife are affected, contradicts the idea that inhalation is the most common method of infection, and even in these ten per cent. it is doubtful whether or not both had been tuberculous previously. Even in animal experiments, it is difficult to infect by spraying particles of dust laden with tubercle bacilli, except under the most favorable conditions of infection, which are rarely present. On the other hand, we see frequently that a rabbit infected at the tip of the tail or in the testis becomes the victim of pulmonary tuberculosis. According to the author the earliest diagnosis of tuberculosis requires an examination on the part of the family physician of the following classes of patients:

1. All members of tuberculous families, for they are to be suspected of tuberculosis.

2. All individuals, whether members of tuberculous family or not, who show signs of atrophy or dystrophy (debility, retarded development, anæmia, malformations, anomalies of the genitals, etc.). Such persons are also to be suspected.

3. All individuals who show traces of glandular swellings, scars, phlyctenulæ, bone disease, changes in the pulmonary apices or in the pleura, are or have been tuberculous, especially if they belong to the classes described under 1 and 2. The examination must not be limited to the investigation of the pulmonary apices and of the lower borders of the lungs, but must be made to include also (a) the joints, the glands, and the abdominal organs; (b) the temperature by rectal measurement. Rises before menstruation, after taking a walk, and febrile movements which

persist and are out of proportion in slight ailments, should lead to a suspicion of latent tuberculosis ; (c) the use of tuberculin in corroborating the diagnosis. (*Aerztliche Rundschau*, 1902, No. 25).

PERCUSSION OF THE LUNG APICES ACCORDING TO KRÆNIG'S METHOD.

Alfred Wolff (*Deutsche medicinische Wochenschrift*, February 5, 1903, Vol. 29, No. 6, p. 93) gives the results of his experience in the early diagnosis of tuberculosis of the lungs by means of Krænicg's method of percussion. In 1889 Krænicg published a method which he called topographical percussion (*Berl. klin. Wochenschr.*, 1889, No. 37) and more recently (*Medicinische Woche*, 1901, No. 15) he called attention to the advantages of this means of diagnosis. In the meanwhile, the original article attracted less attention than it deserved, and only Oestreicher's paper (*Zeitschr. f. klin. Med.* 1898,) has been published since then, speaking of the advantages of Krænicg's method, whereby the author was able to discern in the apices foci of the size of a cherry.

The essential idea of Krænicg's method is that there is no such thing as an upper margin of pulmonary percussion of the apex, but that the percussion-note extends over the shoulder. It is just as important to percuss the apex behind as in front, though the former is more difficult on account of the greater thickness of the muscles there. The method consists essentially in percussion of the apex of the lung in such a manner as to determine the projection of the apex upon the skin over it. For this purpose it is necessary to fix the outline of the area of pulmonary resonance over the apical region, across the shoulder. The narrowest part of this projection of pulmonary resonance is called the apical isthmus, and it was found that this isthmus is about 4 cm. in width in normal apices, while in retraction it becomes narrowed to 1 cm. and less. In infiltration this narrowing is less marked, but still sufficiently distinct. Krænicg's method is therefore not to be relied upon alone for the diagnosis of the apical condition, but it is of use in helping to decide as to the character and extent of the lesions. In infiltration there is a narrowing of the isthmus, but besides, there is a lack of the sudden transition from the dullness to normal pulmonary resonance, and instead there is a gradual transition to relative pulmonary resonance, followed by gradual entrance into the narrowed isthmus described. By auscultatory percussion one can also determine whether the isthmus found by ordinary percussion is nar-

rower than it had been when the apex was healthy, as by auscultatory percussion one gets the full outline of the apex in resonance in spite of the presence of infiltration. The method is easily learned and is theoretically correct, as it furnishes the resonance of the apex in its full outlines. The finger or a special pleximeter must be held parallel to the outline of the area percussed, and the ear must be rather more sharply perceptive of the differences in resonance than in ordinary percussion. It goes without saying that the force of percussion must be very slight, in order to exclude transmission of the apical resonance to the rest of the lung and so avoiding an exaggerated resonance.

THE PHENOMENA OF TIDAL PERCUSSION AT THE APICES OF THE LUNGS AND THEIR INTERPRETATION.

Dr. E. H. Colbeck (*Practitioner*, March, 1903), in a recent article shows that the phenomena commonly known as tidal percussion at the apices of the lungs are usually misrepresented and misunderstood. Tidal percussion, as it is termed by Philip, (*Practitioner*, January, 1903), has been practiced for many years, and consists of percussion over the apices, or for that matter, over other portions of the lungs, alternately during expiration or easy respiration, and during full inspiration. The current teaching is, that the limits of supraclavicular resonance increase with full inspiration and decrease with expiration. The author has been for some years convinced that this teaching is absolutely erroneous.

In 1901 he published, together with Dr. Pritchard, a paper in the *Lancet*, in which they drew attention to the importance of investigating the tidal percussion at the apices of the lungs in pulmonary tuberculosis. They concluded that the tidal percussion-phenomena were exactly contrary to what was ordinarily taught and accepted. They found that the pitch of the percussion-note over the supraclavicular space rises from below upwards during full inspiration, and falls from above downwards during expiration. In other words, they observed a decrease in the limits of the pulmonary resonance over the supraclavicular fossæ during inspiration, and an increase during expiration. Since then investigations which the author has carried on confirmed these conclusions.

In the first place, the anatomical relations of the apices are such, that, contrary to the accepted idea, there is no expansion of the lungs into the neck during inspiration. The fascial coverings of the apices do not become distended in inspiration and in the apices, being extrathoracic,

cannot be distended by the movement of the thoracic walls. During full inspiration the clavicle and the first rib are raised, so that the distance of the apex of the lung from the upper border of the clavicle is lessened. Moreover, in consequence of raising the first rib, the fascial coverings of the apex become less tense and rather slack, and so the atmospheric pressure has more chance to press upon the apex, thus pushing it downward. Hence, the anatomical conditions of the apex render it impossible that the lung should rise above the clavicles higher during inspiration than during expiration.

Clinical evidence also tends to corroborate this theory. In the first place, on mere inspection, we often see that the supraclavicular spaces are sucked in during inspiration. This phenomenon is so obtrusive, especially in cases of tuberculosis, that it is surprising how any clinician can reconcile it with the accepted theory of tidal percussion.

In healthy subjects supraclavicular resonance can usually be obtained, as Philip justly points out, for about three finger-breadths above the clavicles. If now a full inspiration be taken, the note over the second finger becomes increasingly higher-pitched, while over the third finger a dull note is obtained. If at the end of full inspiration the glottis is closed and the thorax "let go", the note over the second finger becomes slightly lower in pitch (i. e., more resonant), showing that the air has been driven into the apices. In order that these signs may be most clearly elicited, percussion should be lightly made from the wrist only, while care must be taken to exclude the clavicular note. In cases of pulmonary tuberculosis the signs just described are emphasized and exaggerated. Thus the note over the first finger is frequently raised in pitch, while over the second and third fingers it is absolutely dull. In extreme instances there is absolute dullness over all three fingers during inspiration, with resonance sometimes more or less impaired over the first finger and possibly the second during expiration.

SYPHILIS OF THE LUNGS SIMULATING PULMONARY TUBERCULOSIS.

Dr. Alfred Stengel (*Univ. of Penna. Med. Bulletin*, May 1903) says :

Numerous references might be cited from the older literature of syphilis to show that syphilis of the lung was recognized, but most authors who discussed it regarded constitutional syphilis only as a predisposing, or one of the direct causes of phthisis. Up to the nineteenth

century there was no distinction of the destructive lesions of the lung, and tuberculosis was not regarded as a distinctive disease independent of syphilis and other conditions. After the time of Lænnec and his contemporaries all nodular affections were classed as tuberculosis and the occurrence of a pulmonary form of syphilis was generally doubted. Most pathologists of the period antedating the discovery of the tubercle bacillus classed all disease of the lung with nodular formations as tuberculous. Virchow, however, directed attention to the possible syphilitic nature of many such conditions. In the light of present knowledge more definite conclusions can be reached, but, as yet, no satisfactory investigations have been made.

Those who rely largely on clinical studies have found syphilis of the lung more or less common. On the other hand, clinicians of a pathological bias still insist upon the rarity of pulmonary syphilis. Osler, in twenty-five years, recalls but a half dozen cases, and Fowler found in the museums of London only twelve instances, of which two were doubtful. This apparent infrequency is undoubtedly in part the result of actual rarity, but may be due in part to failure of the pathologist to recognize syphilis. The great frequency of tuberculosis still causes pathologists to regard every nodular disease as such. Despite the influence which Virchow exercised to correct doubtful impressions, the continued disposition to regard pulmonary syphilis as a great rarity is due in a measure to his own writings. He, however, did not deny the syphilitic nature of some of the nodular conditions of the lung recorded in earlier literature. After referring to instances of gummatous disease of lungs recorded in earlier literature he remarks: "Though many of these occasion a feeling of doubtfulness I am far from believing them all questionable. My experience inclines me to great caution. The mere coincidence with other syphilitic lesions does not decide the question, for why may not a syphilitic develop tuberculosis of the lung or a cheesy pneumonia. To determine the syphilitic nature of a given nodule in the lung we need, beside the history and coincident lesions elsewhere, to find a connective tissue matrix. The exudate must not lie free, i. e., must not be of catarrhal origin.

"Genuine gummata may occur in the lungs of adults. There are various nodules highly suggestive of syphilis, but as similar nodules occur in peribronchitis and chronic pneumonia without syphilitic history, I cannot ever regard such as syphilitic with certainty. The disease known

as grinders asthma in England presents lesions of the kind just referred to".

The lesions of pulmonary syphilis in adults may be discussed under three heads: 1. Gummata. 2. Changes in connective tissue. 3. Changes in the parenchyma.

1. *Pulmonary Gummata.* While it is probable that at the present day gummata are frequently called tubercle, it is equally probable that tuberculous nodules were thought syphilitic by early observers. In some cases the specific nature of the lesions is quite certain. Wagner describes a case in which there were sharply defined nodules in the left upper lobe, walnut-sized, greenish-gray, or brownish-red. The intervening pulmonary tissue was dry and pigmented. The lower lobe showed similar nodules. The bronchi contained yellowish muco-pus.

Virchow describes cases of multiple indurative pleuro-pneumonia, the lesions occurring near the surface under the pleura. Lesions near the surface are scarlike; those in the interior of the lung are nodular. Certain areas may present a cheesy appearance, giving the nodule the appearance of gumma of the periosteum or liver. He reports a case in which the occurrence of distinct gummatus nodules in the lungs as well as the history and specific lesions in other organs made the syphilitic nature of the pulmonary condition quite certain. The similarity of lesions in the lungs of syphilitic new-born children give additional support to his opinion. Similar cases are referred to by Fowler and in one of these reported by Wilkes the upper lobe of one lung presented two masses circumscribed, firm, yellowish and dry, on section resembling gummata of the liver. Histologically the lesions consisted of fibroid tissue with areas of caseation and a few giant cells.

In an autopsy by the author the right lung was attached by a mass which invaded the bodies of the vertebræ and ribs. The growth was yellowish, semi-gelatinous in appearance, firm, with no evidence of breaking down. The vertebræ and ribs invaded were somewhat necrotic. The growth invaded the lung and the bronchus and its primary branches were compressed. The cartilages were fragile and in places fractured. Post-bronchial glands enlarged and œdematous. Microscopic examination of mass showed proliferating connective tissue with fatty detritus. No true caseation.

2. *Changes in Connective Tissue of the Lung.* While the existence of gummata associated with more or less diffuse fibrosis cannot be questioned, it is also probable that fibrosis independent of nodular lesions

may be of syphilitic origin. Virchow found such lesions common about small bronchi, the pleura and parenchyma of the lung, and regarded them as analagous to specific inflammations of the liver, testes, etc.

Greenfield describes a case of fibrotic variety presenting a puckered cicatrix of the lower right lobe, with fibroid bands running into the pulmonary tissue ; no caseous or calcarious nodules. Schnitzler and Hiller report similar cases.

Histologically in all these cases the important condition has been the fibroid proliferation and infiltration.

3. *Parenchymatous changes.* It is uncertain whether the parenchymatous changes occurring with nodular and fibroid syphilis are to be interpreted as syphilitic or as merely the result of mixed infection or of compression exercised by the growing nodules and connective tissue.

Virchow is inclined to be skeptical regarding the syphilitic nature of cases of multiple and circumscribed catarrhal broncho-pneumonias, sometimes regarded as of specific origin. Abundant clinical evidence alone, he said, could determine the question. This opinion, however, was given before the discovery of the tubercle bacillus and at present the decision depends largely on the presence or absence of this microorganism.

The implication of the parenchymatous structure in the syphilitic processes in the lung was shown by Councilman, who found that in the formation of gummata in the lungs, a pneumonia with fibrous exudation is an essential part.

Another element in the production of extensive and sometime destructive lesions in the lung in syphilitic disease is the compression or stenosis of the trachea and bronchi. The effects of compression of a main bronchus by aneurism may be here recalled. Under these circumstances the affected lung may collapse and later undergo inflammatory and degenerative changes with possibly focal softening and necrosis.

Syphilitic Phthisis. Clinicians have frequently described ulcerative and destructive changes under this name and the possibility of its occurrence has been much discussed. Destructive and necrotic processes may occur in the lungs in association with syphilitic disease of the trachea or bronchi and with nodular or diffuse gummatous formation, the gummata themselves frequently undergoing caseous softening with formation of cavities.

Another variety of cavity formation is that which results from the dilatation of the bronchi with formation of bronchicetases. Such cavities occur singly or in considerable numbers, and when in association with

diffuse syphilitic infiltration give the organ a peculiar ulcerative appearance. Necrotic changes may occur in the broncho-pneumonic portions of the lung between gummatous nodules, or independently of gummata, when there has been a long standing obstruction of the main bronchus.

Those who object to the existence of a special form of syphilitic phthisis, however, have not in mind such cases as these, but rather a condition of diffuse infiltration with necrosis and ulcerations of affected areas, such as is characteristic of tuberculosis. It cannot be denied that the evidence is unfavorable to the acceptance of such a condition. Viewing the matter from this rigidly pathologic standpoint there is no essential difference between nodular and diffuse syphilitic processes in which ulceration occurs, and those in which necrosis is wanting. The softening of the gummata or intervening tissue, or formation of cavities, is in the nature of a sequel or accidental accompaniment. The term, syphilitic phthisis, therefore, if adopted at all, is one of purely clinical significance.

Fowler thus summarizes the points of difference between pulmonary lesions of tuberculosis and syphilis :

1. Tubercle usually affects the apex of the lung first, while the primary lesion of syphilis is often about the root and central part of the lung. Tubercle advances along a certain route while gummata may be found in any position and spread without a definite march.
2. Tubercles and gummata may undergo caseous or fibrous transformation but caseous gummata rarely form cavities, while this process is the rule with tubercles.
3. Progressive destruction of lungs and increase in size of cavities is common in tuberculosis, but rare in syphilis except as result of stenosis of the main bronchi.
4. In nearly all cases of advanced destruction of the lung in syphilis, stenosis of the trachea or of a main bronchus is present, while this lesion is rare in tuberculosis.
5. Cavities in syphilis are usually bronchiectatic. In tubercle they are due to progressive destruction of the lung, but may be bronchiectatic.
6. Pulmonary aneurisms, so common in tuberculosis, are rare in syphilis.

These distinctions accord with the conclusions of the author.

Symptomatology. The symptoms and physical signs of syphilis of the lung are sometimes so ill defined that the condition is not recognized until the autopsy. In other cases marked symptoms and physical signs

are observed, but even then they are not such as positively to indicate syphilis. Some cases simulate tuberculosis so closely that a clinical distinction cannot be made and even at the autopsy the lesions are far from distinctive. Present knowledge does not warrant any more positive statement than that when the history of specific infection is certain and specific lesions are found in other organs, any evidence of pulmonary disease should be considered possibly syphilitic, especially if repeated examination of the sputum fails to show the tubercle bacilli.

A review of symptoms as found in reported cases follows :

Cough is of variable intensity ; sometimes altogether wanting ; sometimes out of proportion to amount of disease present. When bronchiectases have formed there is periodic cough with evacuation of contents of the cavities. Dyspnoea is variable. Virchow points out that in cases where considerable fibrosis surrounds the bronchi there is a tendency to an asthmatic condition. Expectoration is usually present, but may be scanty. With the evacuation of the bronchiectatic cavities there is an abundance of ill-smelling sputa. The sputum is not characteristic but is usually more offensive than in ordinary phthisis. Hemoptysis is rare, though cases are recorded of the expectoration of large quantities of blood. Pain may be caused by the involvement of the pleura or bony structure but is less frequent than a sense of constriction and oppression. Fever is nearly always found at some period, although some authors believe otherwise and have based the diagnosis of syphilitic phthisis on this supposition. When gummatous involvement of the lung is extensive, fever is more or less continuous and may assume the hectic type. Emaciation is less pronounced than in tuberculosis.

Physical Signs. Consolidation of portions of the lung is usually discovered, frequently in the right middle lobe. Consolidation in the latter area has been considered diagnostic. Numerous cases, however, are reported in which the apex, right or left, was affected first and the middle right lobe uninvolved either primarily or secondarily. The physical signs of consolidation do not differ materially from those of tuberculosis. One character of peculiar significance is the occurrence of dense consolidation with great feebleness of respiration. This may occur in tuberculosis but is more pronounced in syphilis. Cavities caused by necrosis of gummata give the usual signs. Signs of stenosis of bronchi or trachea may be well marked. Associated luetic lesions in other situations are always significant, such as ulcers, scars in the skin, exostosis of the tibia, cirrhosis and perihepatitis, fibroid orchitis and catarrhal or cicatricial con-

ditions of the larynx. Amyloid disease and albuminuria have been mentioned among symptoms.

Diagnosis. The diagnosis of pulmonary syphilis cannot be made with certainty, although it may often be suspected. Pulmonary disease with symptoms and signs practically identical with tuberculosis may be due to syphilis and when repeated examinations of sputa fail to demonstrate tubercle bacilli and there are present evidences of syphilis of other organs, anti-syphilitic treatment should be instituted.

It must not be forgotten that tuberculosis may occur in syphilitic persons and that earlier writers believed that constitutional syphilis occasioned a predisposition to tubercle.

Recovery under anti-syphilitic treatment does not prove conclusively the syphilitic nature of the case, for spontaneous cures of tuberculosis are not infrequent.

THE THERAPEUTIC AND DIAGNOSTIC VALUE OF TUBERCULIN.

Richard Adler (*Prager med. Wocheschr.*, Vol. 28, 1903) thinks that the public sanatorium idea which has been received so enthusiastically in Germany does not constitute the solution of the problem of curing tuberculosis. Recently a number of authors have shown by statistics that the sanatorium treatment of tuberculosis does not cure more than 25 per cent. of the mildest and earliest cases, i. e., if the presence of a reaction to tuberculin be, as it should be, considered an evidence of incomplete cure. When the fact that 97 per cent. of all persons over eighteen years of age are tuberculous (Nægeli) be remembered, and when we consider that there are at present 39 sanatoria in operation in Germany, 19 in the course of construction, and 16 projected, it will be clear that sanatoria can have but a slight influence in diminishing the number of cases and in curing the existing ones. Reiche showed that in 60 per cent. of those patients who were discharged without any objective signs in the lungs from a sanitarium, there was a relapse of the physical signs within a year. Hammer found that the results obtained in walking patients in the Heidelberg Poliklinik corresponded very closely to those obtained in sanatoria, and concluded that the sanatoria did not offer any marked advantages over the ambulant treatment. Reiche recognizes, however, the fact that the training which patients obtain as regards the mode of life, hygienic and dietetic measures, etc., is of great value, and that the sana-

toria are the places where this training is best obtained. Koch's tuberculin was first introduced thirteen years ago, but the first enthusiasm which arose when it was announced died out almost completely within a year, and in 1892 there were but few reports as to its value in literature. Today tuberculin is but rarely used by the majority of general practitioners, and the prejudice against it in some quarters is so strong that the author was told recently by a physician, that the diagnostic injection of tuberculin was a crime. Koch's new product, tuberculin R, the production of which was announced in 1897, aroused but a slight response in the form of a small number of reports on its use. Only a small number of physicians remained true to the remedy. The largest material and the longest periods of observation has been furnished by Gœtsch, who published his results last year. He reports 224 cases of which 174 had been under observation for a sufficiently long time to secure complete reports. Of these 125, or 71 per cent., may be considered as completely cured. Other authors, such as Thorner, of Berlin, Carl and Lucius Spengler, of Davos, Turban, of Davos, Rembold, of Stuttgart, Krause, of Wied, Bandelier, of Kottbus and Petruschky, of Danzig, reported favorable result with tuberculin. The condemnation of 1891 was premature and hasty, and all the opponents of tuberculin to this day cannot deny the accusation of insufficient trials and short periods of observation.

The present author treated about twenty patients with tuberculin, in addition to having employed this remedy as a means of diagnosis in numerous cases. His experience proves what has already been stated in recent literature, namely, that it is possible to administer tuberculin without any inconvenience whatever to the patient, provided the proper method is used. The results showed in all cases more or less prompt improvement in the symptomatic features of the cases, and disappearance of the local lesions. He gives the following scheme for using the remedy, prefacing his directions with the statement that a rule cannot be made to apply to all cases, and each individual must be treated according to the manner in which he reacts. The less experienced physician will in all instances choose the mildest cases first, then gradually daring to treat the more severe forms.

As a rule only patients without fever should be treated with tuberculin. Their fever must be removed, if needed by rest in bed, cold frictions, and treatment in a sanatorium. This precaution is especially to be observed by the beginner in tuberculin treatment.

The initial doses should vary with the individual. As a rule 0.00005

g. of Koch's old tuberculin should be begun with. In some cases 0.00001 g. is the best beginning dose, especially for beginners. The injections are repeated once a week and after four or five weeks the dose is slowly increased, provided the reaction does not exceed a few tenths of a degree after each injection, and provided no marked constitutional effects, such as headache and malaise follow. If a certain dose produces disturbances it is to be repeated until the susceptibility disappears. The increase is to be made gradually, as a rule only 0.00001 g. each time. The highest dose is 1 gramme, which is repeated until the patient is cured. Locally the reaction is much more marked at first, so that there is redness and a slight swelling, which in exceptional cases is of larger size. As the patient becomes accustomed to tuberculin, the local reaction diminishes. The author usually injected into the extensor surfaces of the arms. In cases in which the infiltrates tended to be large, the interscapular region was found better. The injections were made during the office hours in the afternoon, and the patient went home and remained in bed the entire following day. Every patient was supplied with a book in which he recorded the temperature measured from three to five times daily, the weekly weight; the number and dates of injections were noted.

Once the proper dose has been found and the patient bears the injections well, the symptoms rapidly diminish and disappear. The cough becomes less frequent and less troublesome, the weight increases, the appetite improves, etc. The mode in which tuberculin was administered in large, frequent and steadily progressive doses irrespective of the nature of the case accounts, in the author's opinion, for the bad results obtained during the first years following its introduction. Every physician should be acquainted with the method to be employed in administering tuberculin, as it gives better results and is a more convenient and trustworthy mode of treatment than any other therapeutic method thus far suggested in tuberculosis. The physician should also be acquainted to a certain extent with the literature of the subject, and should understand the theory of tuberculin and the rationale of its use as a mode of immunization and protection, as well as a means of diagnosis. As a diagnostic means, tuberculin is especially valuable in discovering the hidden, latent and larvated forms of tuberculosis which are masked by other diseases or symptoms, such as chlorosis, and which are now recognized as early stages of consumption.

A CRITICAL STUDY OF TUBERCULIN AND ALLIED PRODUCTS BASED UPON A COLLECTIVE INVESTIGATION.

Dr. F. M. Pottenger, of Los Angeles, Cal., (*Therapeutic Gazette*, March 15, 1903), collected a series of data on the value of tuberculin in the treatment of tuberculosis from three hundred and twenty-five letters of inquiry which he sent out to leading clinicians here and abroad. He received one hundred and forty-three replies to his questions, including answers from Schrøtter and Weismayr, of Austria; Gerhardt, Dettweiler, Weicker, Krause, Gøetsch, Johne, Kohler, Gebhardt, Rietschel, and Møller, of Germany; Turban and Spengler, of Switzerland; Brouardel, of France; Giovanni, of Italy; Ransome, Heron, Latham, Mackenzie, Semon, Yeo and Saundby, of England; and Trudeau, Bowditch, von Ruck, Loomis, Stubbett, Solly and Denison, of this country. Of the one hundred and forty-three who replied, thirty-two, or 22.4 per cent., recommended the use of the tuberculin products; fifty-two, or 36.3 per cent., did not recommend them; while fifty-nine, or 41.3 per cent., expressed no opinion at all. Of the fifty-two who did not recommend them, 34 expressed themselves as not being opposed to them, but simply as not being convinced of their value, although twelve of these acknowledged that the remedies have contributed to cures in their hands. Eighteen were absolutely hostile. Those who recommend these remedies base their experience upon 5742 cases, while those who oppose them base their opinion on 813 cases. Of those who do not recommend them only four have had an extensive experience. Only six of the fifty-two men who did not recommend tuberculin products had tried these for over three months.

The author's conclusions, based on the results of these investigators, were as follows:

1. The interest of the medical profession in tuberculin and allied products is increasing and its attitude is gradually becoming less hostile.
2. The attitude of the profession in Europe is more favorable than in this country.
3. The greatest opposition comes from those who were unfortunate in their experiences when tuberculin was first introduced and those who, although they have had no experience, base their opinions upon this early trial, discrediting the work of recent writers upon this subject.
4. Not one man who has given the later remedies an extensive trial in suitable cases, failed to observe benefit from their use.

5. The disapproval and rejection of the remedies in most instances is based on faulty application and upon trials in unsuitable and far advanced cases.

6. Those who have studied these remedies most carefully and have exercised the greatest care and judgment in the selection of cases, have almost without exception been convinced of their value ; and they have been able to report enough cases to prove that these remedies will do that for which they are recommended.

7. Basing an opinion on 1200 first-stage cases, 611 of which were treated in sanatoria by the usual dietetic and hygienic measures, and 589 by the same careful management plus tuberculin and allied products, we find that of those treated in the latter manner, 20.2 per cent. more were cured than where the tuberculin preparations were omitted from the treatment.

8. In patients treated with tuberculin and allied products, there is less tendency for the disease to spread to new tissue, and when an apparent cure is attained there is less danger of relapse.

9. Tuberculin and the allied products are fast becoming established as therapeutic measures in the treatment of tuberculosis, and are worthy of the earnest attention of the medical profession.

THE PRESENT STATUS OF THE QUESTION OF SERUM-THERAPY IN TUBERCULOSIS.

O. I. Braunstein and L. J. Fraenkel, of Moscow, (*Roussky Archiv Patologyi, Klinitcheskoy Meditsiny i Bakteriologiyi*, December 31, 1902, p. 1147,) in a critical review of the subject of serumtherapy of tuberculosis present a summary of the data on which a judgment of the status of the question of specific treatment in tuberculosis may be based. They start by saying that: "While the employment of serumtherapy has not acquired the rights of citizenship in practice, yet, from a theoretical point of view, a great deal has been done towards solving this problem." The curability of tuberculosis, a belief of the older clinicians like Buhl, Niemeyer, etc., is now an axiom, and yet the various therapeutic methods employed in treating this disease, such as climatotherapy, ærotherapy, dietetic treatment with koumyss, grapes, muscle plasma (zomotherapy), have given such scanty results, that the profession has of late been turning away from the thankless problem of actually curing tuberculosis, and has devoted itself to the prevention of the disease. Bacteriology

which has given us a knowledge of the exciting cause of tuberculosis, has also placed in our hands an entirely new arsenal of methods whereby artificial immunity against this cause may be induced.

The first attempts to treat tuberculosis specifically were by the so-called methods of microbotherapy. In 1886, Cantani, having convinced himself of the harmlessness of the cultures of *bacillus termo*, in man, injected it into tuberculous patients, with a view of antagonizing the development of the tubercle bacillus in their bodies by this means. Later it appeared that the *bacillus termo* was only a name for a variety of pyogenic microbes, and it is well known what a deleterious influence these germs exert in tuberculosis. De Toma removed all plausibility from the method of Cantani by his investigations into the *bacillus termo*. The same may be said of the method proposed by Petruschky, of injecting streptococcus cultures into patients with lupus. The experiments of Portucalis, with inoculations of syphilis into patients who have tuberculosis, are unique in their daring and have not been repeated by other investigators, but the author named regards the results obtained as signs of an antagonism between the germs of these two diseases.

The rise of the theories of general immunity which took root about the eighties of the past century forced the question of specific treatment of tuberculosis towards serumtherapy. Richet and Héricourt were the first to experiment on this subject. They first tried to inject the serum of animals naturally immune from tuberculosis into susceptible animals, thus hoping to render the latter immune. While the immunizing effect of these injections was appreciable, all the animals died sooner or later from the infection. In 1891, two years after the beginning of these experiments, the serum of a non-susceptible animal, a dog, was used in a case of laryngeal tuberculosis in one of the Paris hospitals by Héricourt, Langlois and St. Hilaire. The patient improved considerably, but tubercle bacilli did not cease to appear in his sputum. This method found but few adherents. Pinard in newly born infants, and Feulard in lupus cases, reported good results, but Tommasoli did not get satisfactory results in lupus.

The serum of goats was used next, with analogous results. Encouraged by their success in rabbits, Bertin and Picq reported the successful use of goats' serum in tuberculous patients at the Paris Congress of Tuberculosis. Lépine and Bernheim made similar reports, but in 1892 Bouchard clearly showed by experiments on guinea-pigs that the serum of goats has no effect. The attempts of Silverstrini and of Baduelli to find

a specific immunizing substance in glycerine-aqueous extract of the organs of goats may also be classed with those enumerated above, and the same may be said of the attempts of Roger and Cadiot to use the dog for the same purpose. Cadiot, Gilbert, and Roger found the blood-serum of hens, which were thought to be immune from human tuberculosis, useless; and the same authors demonstrated that the dog and the goat are susceptible to human tuberculosis, and that hens are relatively susceptible to the same. All the investigations made in this direction have therefore lost the ground on which they had stood.

The next step was based upon the idea that in the blood of tuberculous animals there exists besides the toxin, also an antibody which is capable of protecting against the bacillus. This led to the injection of the serum of animals that had been previously infected. This method, first suggested by Richet and Héricourt, was first applied in man by Broca and Charrin in 1895. On July 27th of that year these authors communicated to Société de Biologie in Paris the successful results of their experiments in treating lupus and general tuberculous infections of the skin by means of the serum of tuberculous dogs. Silverstrini, who repeated these experiments on animals, did not find this method satisfactory. Viquerati next occupied himself seriously with the investigation of this method, using mules, especially older animals, for this purpose. By infecting these mules with cultures of tubercle bacillus he produced what he claimed to be an antituberculin which if injected into animals and into man protected against the tubercle bacillus. He claimed to have obtained brilliant results in man. But Rutkowsky, in the same year, 1896, on repeating Viquerati's experiments came to a diametrically opposite conclusion, that the serum of these mules, not only failed to protect, but proved to be actually injurious, in some cases killing the animals. A number of authors since then have attempted to work on the lines laid out by Richet and Héricourt, injecting the serum of tuberculous animals, but no success attended their efforts, the improvement being only temporary or else being also possible with injections of the serum of any animal. Exceptions seem to be found in the cases of De Coster who cured completely a woman aged 79 years of tuberculous swelling of the neck by simple injections of the serum of a goat; and those of Dunwoody who cured himself and a number of patients of tuberculosis by means of injections of the serum of a normal horse.

In the light of the sensational investigations of Bordet, Metchnikoff and his pupils, and Ehrlich and his school, we would say to-day that the

benefit derived from the injection of these serums lay not at all in any specific antituberculous property, but simply occurred in virtue of the law of Weigert who found that the injection of a serum of one species of animals into another produced a stimulation of the blood-forming organs in the second animal and so increased the resistance of the body against infection.

The next step was the use of the serum of animals immunized against tuberculosis. This was done in one of two ways, either by injecting first minimum doses of culture and gradually increasing the dose as the animal was becoming accustomed to the toxins; and second, by injecting attenuated cultures, and gradually increasing their virulence. The experiments of Grancher, and Ledoux-Lebard belong to the first category, but they were never able to test the efficiency of the serum they had made, for their animals died after the injection of 0.001 milligramme of dry bacilli. The use of attenuated and dead cultures was also the feature of the methods employed by a variety of other experimenters, such as Turkiné (1897), Darenberg, Mafucci and Di Vestea, but without satisfactory results.

In 1897, Trudeau employed a six-year old culture of tubercle bacilli for inoculating guinea pigs with the result that all but a few died. On injecting the surviving animals with a virulent culture, the animals lived on an average of eighteen months. De Schweinitz perfected the method of obtaining attenuated cultures. He grew the bacillus of tuberculosis for prolonged periods on weakly acid media, made emulsions of them in distilled water, shook and mixed these in a mechanical churner, allowed to settle, centrifuged, and thus freed them from fat and other extraneous matter, and finally injected them into horses. An antitoxic serum was obtained after eighteen months, which was used at the Liberty Sanitarium by Schweinitz, giving 20 per cent. of recoveries, and also by Loomis, Trudeau and Stubbart.

The difficulty in obtaining the desired degree of immunity lay, it appeared, in the impossibility of obtaining all the poisonous substances which play a rôle in tuberculosis. These are evidently not all contained in the bacilli themselves. A number of investigators, believing that Koch's tuberculin did not contain all the active toxins of tuberculosis, proceeded to obtain more highly toxic compounds by getting an animal organism to manufacture them on a larger scale. For this purpose Redon and Chenot, 1895, Peron, 1897, Ferran, Maksutoff, etc., employed various modifications with the idea that more perfect immunizing sub-

stances may be manufactured by the injection of bacilli into animals, after variously modifying the virulence of the germ. These experiments did not prove very successful.

The trouble with the experiments hitherto reviewed had been that they lacked the strict logic and system of those which led to the discovery of the diphtheria and tetanus antitoxins by Behring, Roux, and Kitasato. The next phase in the evolution of the question included studies which were based on the idea of Koch that his tuberculin contains the quintessence of the toxic principles of tuberculosis. Tizzoni and Centanni proved the immunizing power of tuberculin in guinea-pigs, and the same question has been more thoroughly studied by Behring in 1895. In 1895, Boinet, having obtained good results in guinea-pigs by the injection of the serum of a goat immunized by the injection of tuberculin, employed the same serum in man. Improvement was noted in five out of eight cases. Fisch, of New York, in 1897, tried an antituberculous serum, similarly prepared in horses, upon guinea-pigs and monkeys and found that it produced an antitoxic and preventive effect. Several American physicians used Fisch's serum in man. Thus Holmes treated 31 cases for from one to eight months. Two died, in two there was no improvement, and the remaining 27 considerably improved, some of them were cured so far as tubercle bacilli in the sputum and physical signs were concerned. At the same time Freudenthal obtained discouraging results in four patients. Hinsdale, Lemen, Williams, and Horrocks, and other American physicians, report successes with similar serums, but unfortunately no detailed data are given as regards the methods of immunization, the kind of animal used, etc.

Koch himself admitted that the sum of the toxins of tuberculosis is not represented by extracts from the bodies of the bacilli, for the toxins are diffusible toxalbumins, which become dissolved in cultures, etc. Clinicians claim, too, that the symptoms of tuberculosis in a large measure are due to the diffusion of these very toxins. Bernheim studied most thoroughly the effects of these diffusible extra bacillary toxins, and was able to immunize animals with the filtered fluid of tuberculosis cultures. The most recent investigators employed, therefore, the greatest possible range and variety of tuberculous toxic principles for immunization. Thus Niemann made tuberculin by Koch's method from a very virulent culture, injected it into young goats, then injected into the same goats the alcoholic residue of the extraction of tuberculin. The serum thus obtained was immunizing in animals, but in man it did not cure the disease,

although it prevented the occurrence of the tuberculin reaction after a time.

Paquin, in 1895, in America injected into horses first the sterilized (?) bouillon, filtered from tuberculous cultures, then dead bacilli and finally, live germs. According to this author, the normal serum of the horse is antagonistic to the disease, but this process raises its anti-tuberculous powers. The serum of a horse immunized for three months arrests tuberculosis in the early stage, provided the treatment be continued for from three to four months. Hewetson tried Paquin's serum on animals and Schropshire in man, but came to diametrically opposite conclusions. The first does not consider it all specific, the second records a series of cures.

In addition, a number of authors tried to obtain poisonous substances of various kinds from cultures. Among these may be mentioned: Klebs and his antiphthisin, Hirschfelder and his oxytuberculin, Landmann and his tuberculol. As yet the results with these substances in practice are confusing.

Maragliano's method applies most completely the idea of a universal immunization. Another advantage of the Maragliano method is that it has been more thoroughly tested clinically than any other mode of serum therapy employed in tuberculosis. Maragliano is indeed himself a clinician of the first order and not merely a bacteriologist. He applied himself first to the detailed study of the poisonous elements of the tuberculous culture, and isolated a whole series of such poisons. His method differed from his predecessors and contemporaries in the following points: The number of poisons isolated from the cultures had been quite large, but in addition, Maragliano has studied some new ones. The toxins which are used to immunize animals in his method are employed in a perfectly pure state, and all the toxic substances are employed in the immunization. The test of virulence is made on healthy animals, not on tuberculous. The details of the method of isolating the different toxins used by Maragliano are given in his special articles on the subject. His chief care is directed towards the perfect purity of his tuberculin and its freedom from glycerine, which according to the Italian savant enhances the toxicity of the agent. (Koch's tuberculin consists of about 50 per cent. glycerine.) The method of Maragliano took a number of years to work out, and his first experiments in this field were performed in 1890. In 1895 he reported to the Tuberculosis Congress in Bordeaux, 82 cases of which 61 recovered after the use of his serum. His latest communication reports a total of 2,897 cases and was written by his pupil Mircoli. Of the 250 cases of

apyretic tuberculosis 95 recovered completely, 110 improved, 30 remained stationary, and the remaining 15 progressed in spite of the treatment. Of 988 febrile cases 168 were cured, 511 improved, 163 were stationary, and 93 grew worse. Of the cases of diffused broncho-pneumonia without mixed infection, 665 in number, 92 recovered, 301 improved. In 332 cases with mixed infection 31 were cured, 142 improved, and 61 became worse, while 98 remained stationary. In 712 cases of broncho-pneumonia with cavities, 218 were cured, 290 got worse, and the remainder were stationary. Maragliano's method has met with approval, especially in Italy, where over 200 articles have already appeared in its favor. In France the profession is as a whole skeptical, although Landouzy says that this method is an advance, though the remedy does not act favorably in all cases in which it seems indicated. Very few studies have appeared in Germany in which the results were contradictory to Maragliano (Hagar, Bussenius). In Russia the author's article alone represents the laboratory side, while a few cases have been reported by Griefenhagen of Reval and Zagumenny of Moscow.

Serum-therapy has therefore not yet spoken its last word in tuberculosis. Heretofore all progress therein has been made by groping, so to speak, in the dark, and even Maragliano's most carefully elaborated method leaves much to be desired. The trouble seems to lie in the fact that we are not as yet able to isolate a toxin which has the ideal virulence as we have already done in diphtheria and tetanus. The question as to whether serum-therapy or the method of active immunization (tuberculin and allied products) which has recently been revived after a lull, will lead to the perfection of the specific remedy against tuberculosis, must be left open. As Strauss says, it is a problem, the solution of which will not long be lacking.

COLLECTIVE INVESTIGATION CONCERNING THE VALUE OF SILVER NITRATE INJECTIONS IN THE TREATMENT OF PULMONARY CONSUMPTION.

Dr. Thomas J. Mays (*Philadelphia Medical Journal*, March 14, 1903) reports the results of a series of clinical investigations with the use of silver nitrate in the treatment of consumption. Convinced of the efficacy of this method, the author collected the opinions of a number of physicians on its value and presents the results in this article. He gives the condensed histories of fifty-five cases of consumption. Of these there were

arrested, eleven ; improved, twenty-two ; not improved, seven ; and died, fifteen. Twenty-four patients gained in weight, an average of ten pounds each. Of the fifteen incipient cases seven were arrested, and eight improved. Of the twenty-two advanced cases five were arrested, ten improved, four not improved, and three died. The number of far advanced cases was eighteen, of which none were arrested, four were improved, two were not improved, and twelve died.

In commenting upon these results, the author says that of all the symptoms which improve after the use of silver nitrate, cough and expectoration respond to the best advantage. Irritation coming from the ear, larynx, trachea, bronchi, pleura, heart, pharynx, stomach, liver, intestines, or from any organ that is supplied by the fibres of the vagi, is apt to produce and excite cough, and so we may have all these varieties of reflex cough. Another variety of cough is the cough of fatigue. It occurs especially in subjects who are hereditarily predisposed to consumption, and they suffer from it when they are physically or mentally overworked. Cough is mainly a nervous act, one which is the expression of pneumogastric irritation, and its relief may be obtained in one of two ways—by narcotics which allay its irritability, or by stimulants or tonics which raise its tone. The first is merely a temporary method, while the second promises to give more permanent results. Strychnine is one of the best remedies for chronic cough, as its action is to raise the tone and strength of the nerve affected.

Applications of mustard or of some other counterirritant to the neck are often all that is necessary to assuage persistent cough. Landouzy believes that the alleviation of cough can best be brought about through the nervous system and to this end he injects water hypodermically into the neck. By irritating the nerve endings, water influences the respiratory nerves and the cough ceases.

From these observations the author concludes that silver nitrate injections, administered subcutaneously in the neck over the region of the vagus, produce a certain degree of stimulation which disseminates itself through the various branches of the nerve and relieves cough in virtue of promoting the tone of the vagus. That silver nitrate possesses the power of alleviating cough is shown by the results collected by the author. Of the fifty-five cases reported, there was no relief of cough in three, improvement in forty-four and complete cessation of cough in six cases. The advantages of silver nitrate injections over narcotics and sedatives are in the fact that the former do not produce any depressant effects on the

heart and nervous system, and that they influence the cough more permanently. In a number of instances reported the cough ceased almost immediately after the first injection, and one physician reports having used these injections in a persistent non-phthisical cough in which all cough medicines imaginable could do no good. In the author's own experience there were also such instances, and he mentions two cases of asthma in which these injections were also of benefit.

The silver nitrate injections also seem to have a very marked beneficial effect upon vomiting in phthisis, as of the five cases in which this symptom occurred, three were greatly benefitted, while in the other two the vomiting was completely checked by the injections. Of the forty-two cases in which night-sweats were prominent symptoms, twenty-seven were improved, fourteen completely relieved, and only one was not improved.

Although it is difficult to explain how the patients gain in strength and weight with the use of the silver nitrate injections, the fact remains that the mode of treatment under discussion gave excellent results in this direction, and sometimes this held good even in advanced cases. The author concludes, with due reserve, that the action of silver nitrate is antagonistic to the complex pathological process known as tuberculosis.

[It is, as the author says, difficult to see the rationale of the action of silver nitrate injections. They were given subcutaneously, midway between the angle of the jaw and the clavicle, over or a little behind the carotid artery. Five minims of a 2.5 per cent. solution of cocaine hydrochlorate were injected first. The needle was then left in the puncture, syringe detached, the syringe washed out with water and five minims of a 2.5 per cent. solution of silver nitrate were injected into the same spot through the needle. If cocaine nitrate can be secured, the two can be mixed in the same syringe. The injections should be given, as a rule, on the side on which the affected lung is situated. The object of the therapy in tuberculosis is not to arrest the cough. The cough of tuberculosis is often, in fact, a necessary phenomenon, whose arrest would be ultimately directly injurious to the patient. In cases in which there is much pain, sleeplessness and discomfort from the cough, small doses of narcotics may be given to relieve the patient. If hemoptysis is going on, we try to arrest the cough with morphine. But as a routine treatment, to use silver nitrate because it is alleged to relieve the cough of tuberculosis by toning the vagus nerve or its branches, does not appear to us as quite reasonable. The results attained with silver nitrate injection perhaps corres-

pond in quality to those obtained with any of the other drugs that have been used in tuberculous patients with the same end, namely the relief of cough. They show, in our opinion, merely that tuberculosis is a disease in which anything, even water injected hypodermically, will at times give subjective relief. Nothing is said, we regret to state, in Dr. Mays article, as to the improvement in the physical signs which followed the use of silver nitrate injections, and this is the only solid criterion of the effect of any treatment in tuberculosis.—E.D.]

THE ABUSE OF DRUGS IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

In its issue of February 15, the *Therapeutic Gazette* contains an editorial article with the title quoted above, in which comment is made upon a recent article by Duncan Turner (*Intercolonial Medical Journal of Australasia*, September 20, 1902). The editorial in question contains many hints as to the trend of therapeutics in tuberculosis. While the therapeutic nihilist may occasionally scoff at the measures which are instituted by other physicians for the cure of disease, it is nevertheless a fact that the institution of these measures is based upon a laudable desire to give the patient relief, and there can be no doubt that the constant striving of the modern physician to find some new remedy which will cure a given disease depends more upon his desire to succor his client than to turn to a novel drug simply because it is new. It is the duty of the physician, on the one hand, not to throw aside, as unworthy, new remedies, until he has given them an adequate trial, and, on the other hand, not to cast aside old ones until he is convinced that the new ones are better. Not only must he be governed in his choice of remedies by these two rules, but he must also remember a most important therapeutic law; namely, that all remedies which possess power are capable when they are abused, of doing harm; and he must also bear in mind that it is unwise to administer to a patient a remedy which a local disease may indicate, but which by its use may cause such a disorder of digestion that the appetite is interfered with, and that assimilation is impaired. We have more than once called attention to the importance of avoiding all drugs, when treating pulmonary tuberculosis, which will in any way disturb the appetite and digestive functions, and so we note with interest an article by Duncan Turner in which he implores the profession to avoid the abuse of creasote and guaiacol in the treatment of pulmonary phthisis.

He cites instances in which the administration of these drugs in doses large enough to promise beneficial results to the lungs has so disordered the digestion as to impair vitality and actually to hurry on the fatal issue. These remedies are chiefly of benefit in the bronchitis which is usually associated with the tuberculous process, but they have no effect in arresting the disease itself. Turner quotes the old motto: 'Take care of the stomach and the lungs will take care of themselves.' There is certainly no disease in which the maintenance of the normal digestive function is of greater importance than in that which we are now discussing.

MULTITOXIN FOR TUBERCULOSIS.

Under this title the author, Dr. John Aulde (*Dietetic and Hygiene Gazette*, May 1903, Vol. XIX, No. 5) tells the medical profession of this country that he has discovered and manufactured a multitoxin for tuberculosis, which, if injected into the system, in eight days, effects an "apparent recovery from chronic tubercular infection."

Dr. Aulde begins by saying that to secure immunity from tuberculous infection the resistance of the tissues against the bacillus and its toxins must be secured and that we need for this purpose a toxin which would be injurious to the tubercle bacillus—a schizomytoxin. The latter, it is the author's "impression," should be the product of cellular activity. According to Aulde, recent investigations in the field of immunity show that the antitoxins of diphtheria and tetanus are simple bodies, while the anti-body of tuberculosis is composed of an intermediary and complement. "It is in consequence of this dual character, coupled with variable conditions not yet well understood, that the therapeutic application of bacteriolytic sera has been hindered. In other words, the employment of a serum which liquefies bacteria has not proved successful in the treatment of tuberculosis, typhoid fever, pneumonia, streptococcus, plague and dysentery, because the toxin in these affections is insufficient in itself to create, through reaction, a single body which enacts the rôle of an anti-toxin. In the case of tuberculosis, tuberculin was foredoomed, because it was employed under mistaken premises, *i. e.*, that the soluble toxin obtained from pure cultures would produce curative effects, no consideration being given to the injurious effects of the living bacilli."

"All the foregoing information has accumulated as a result of experimental and clinical work with the various sera which have suggested

themselves, but failure so far does not preclude the possibility of an artificial product which will take the place of the simple anti-body known as an antitoxin, or of the duplex anti-body composed of two distinct elements, as the intermediate and the complement."

We have quoted the author literally in these passages because we feared to spoil the classical structure of the original by abstracting important paragraphs such as the foregoing. Now comes the crux of the article :

"Acting upon this theory I have made some observations upon the effects of alexin combined with formalin in the treatment of this disease, the following case being offered as evidence of good faith and conscientious endeavor. For want of a better name, I shall refer to the combination as *multitoxin*, since it is actually a union of two toxins, *i. e.*, substances toxic to bacteria or fungi. As a further evidence of its adaptability may be mentioned that this preparation in moderate doses augments cell resistance by increasing the stability of the protoplasm. I assume that the alexin acts as the intermediary body and that it finds its complement in the cell ferment of the protoplasm, formalin acting temporarily as a catalytic."

The following is the formula of the substance injected, *i. e.*, of the so-called multitoxin, which is offered by Dr. Aulde as a specific antagonist of the tubercle bacillus, presumably in the place of the tuberculin which was, according to the author, "foredoomed":

| | |
|----------------------|---------|
| Alexin | m. X |
| Formalin | m. I |
| Aquæ bull. q. s. ad. | m. XXX. |

Mix ten drops of the magical alexin with one drop of formalin and thirty drops of boiling water and we have the multitoxin. The alexin, whatever that may be, acts as an "intermediary", uniting with some defensive substance in the tissues and forming with the latter, under the "catalytic" stimulus of formalin, a true antitoxin against tuberculosis. Dr. Aulde carefully refrains from telling us what his alexin is, in all probability, because he does not know, or perhaps because of reasons sufficient unto himself. He informs us merely that the alexin acts as an intermediary. Now an alexin, according to Buchner's definition, is a proteid bactericidal substance which exists in the normal blood serum and is derived from the leucocytes. Where did Dr. Aulde get his alexin ; in the blood of normal individuals ; in that of tuberculous persons or in a

special bactericidal serum obtained from immunized animals? What laboratory methods did he pursue, and how was he able to isolate a defensive body which, in combination with the cellular product which he assumes to be a complement, constitutes the anti-body of tuberculosis? Where were his experiments recorded? How did he isolate his alexin which is so easily handled and measured by the roughest standard of measurement, the minim?

Now, as a matter of fact, granting even, that Dr. Aulde had been successful in producing an alexin such as that mentioned in his article, and we do not for a moment suppose that he actually did produce it, there are still several discrepancies in his theory, any one of which would absolutely crumble his beautiful structure of sophisms. In the first place, while the general statements which the author makes regarding the complexity of the defensive elements of the organism, as determined by the modern researches of Ehrlich and others, are fairly correct, Dr. Aulde, in his lengthy disquisition on what he terms "the biological aspect of the question", shows a lamentable lack of understanding of the subject of experimental immunity. He confuses the unsuspecting reader with a profusion of technical terms which are, for the most part, evidently not quite clear to the author himself. An alexin is a cytase, a leucocytase, if you will, and is a complement, not an intermediary body as Dr. Aulde would have it. For its action, on the contrary, an intermediate body is necessary. (See Aschoff, Ehrlich's *Seitenkettentheorie*, Jena, 1902, p. 180). Besides a characteristic property of alexines (microcytases, Metchnikoff) is that they lose their immunising powers on being heated to 50°C. Therefore, Dr. Aulde's alexin, if it is an alexin, must be destroyed by being dissolved in boiling water which presumably shows a temperature of 100°C. If boiling water were not already successful in destroying it, the alexin, which is a ferment like substance, would be destroyed, in all probability, by the formalin which the author adds in the proportion of one part in ten parts of the alexin, in preparing his "multitoxin" for injection.

And with this wonderful substance a patient with fully developed chronic pulmonary tuberculosis was "apparently cured" within eight days. This was accomplished, according to the author, by "modifying chemotaxis" and "liquefying and neutralizing the fungus or bacillus responsible for the disease known as tuberculosis".

The article in question does not really deserve to be discussed in a serious medical periodical, but it shows one of the methods by which

physicians who devote themselves to practice and who have no time to study the intricate questions of immunity may be imposed upon by persons who have learned by rote a few technical terms; and who, without possessing even an elementary knowledge of the bacterial toxins and the various anti-bodies, without any laboratory facilities to speak of, and without training in the necessary technique of research, have the impudence to assume that the profession can be duped by their pseudo-science, their "discoveries", and their "therapeutic results".

PRIMARY TUBERCULOSIS OF THE EAR FOLLOWED BY MASTOIDITIS. REPORT OF FOUR CASES.

Dr. M. A. Goldstein, of St. Louis (*Journal of Laryngology, Rhinology and Otology*, March 1902), reports four cases of primary tuberculous otitis followed by mastoid disease. Secondary tuberculosis of the ear is not infrequent. In one series Schwabach found that 6.9 per cent. of the patients had tuberculosis of the ear secondary or associated with pulmonary phthisis. Habermann goes further, for he found tuberculous lesions of the petrosa in 33 per cent. of tuberculous persons at autopsy. While the ear is comparatively frequently affected, in the course of a tuberculous process in the lungs, yet we must not look upon every ear that is affected in such patients as the seat of a tuberculous otitis. Of the thirty-three cases of tuberculous otitis recorded in literature, only three are reported as primary tuberculous otitis. The establishment of a positive diagnosis of primary tuberculosis of the ear is extremely difficult, because it is impossible to eliminate slight old pulmonary lesions which might have become encapsulated, or systemic tuberculous lesions somewhere where they are not accessible to physical examination. There are several facts, however, which show that primary tuberculosis may exist in the upper respiratory passages or in the ear. The tubercle bacillus is found very frequently in the healthy pharyngeal mucosa. Primary tuberculous infection of the tonsils, pharynx, larynx, has also been demonstrated by autopsy. The ear is continuous, from a bacteriological viewpoint, with the upper air passages, for 70 per cent. of all affections of the ear that depend upon infection originate in the pharynx or naso-pharynx. Tuberculous infection should therefore be included in this class.

In order that a case of tuberculosis of the ear may be adjudged as primary, the tubercle bacillus must be found in the discharge, and on

autopsy no tuberculosis must be found in any of the organs of the body. In the four cases reported by the author the clinical and pathological data are such as to justify the diagnosis of primary tuberculosis of the ears. Of the four cases, three involved the mastoid cells extensively, and showed an unusually active and rapid invasion. All of the cases developed from a preëxisting chronic suppurative otitis media, and appeared to be instances of direct infection with the tubercle bacillus. In three cases in which the mastoid operation was performed, the wounds healed by firm granulations, and all evidences of tuberculous trouble ceased with the removal of the local process. This is in direct contrast with the healing of these wounds in patients in whom there is systemic tuberculous invasion.

BOOK REVIEWS.

BEITRÄGE ZUR KLINIK DER TUBERKULOSE. Herausgegeben von Dr. Ludoph Brauer, a.o. Professor an der Universität Heidelberg. Band 1, Heft 2, Würzburg, 1903.

1. Czerny, Geh. Rath Prof. Dr. V., Über die Häusliche Behandlung der Tuberkulose (On the Home Treatment of Tuberculosis).

2. Stoeckel, Oberarzt Dr. W., Zur Diagnose und Therapie der Blasen-Nieren-Tuberkulose bei der Frau. Mit I Tafel (On Tuberculosis of the Bladder and Kidneys in Women).

3. Fischer, Dr. B., Über die Ausheilung grosser Tuberculöser Lungenkavernen. (On the Healing of Large Tuberculous Cavities in the Lungs).

4. Grouven, Priv. Doc. Dr., Anderweitige Tuberkulose bei Lupus und Scrophuloderma (Presence of Other Tuberculous lesions in Cases of Lupus and Scrophuloderma).

The second number of this new series of contributions to tuberculosis contains four articles, the titles of which appear above. We reviewed the first number in our last issue and called attention at that time to the general scope and plan of this publication.

1. Professor Czerny starts with the statement that occasionally tuberculous patients come to him, and when he tells them that they had better consult a colleague who is making a specialty of this disease, they assure him that some friend had been benefited by his advice and had advised them to consult him. This explains the fact that the professor of surgery at Heidelberg enters the field of medical tuberculosis. He reports two cases of pulmonary and surgical tuberculosis in which the old-fashioned home treatment, including the administration of creasote and tincture of gentian; the use of warm baths and inunctions of potash-soap, etc., gave good results as regards

the amelioration of symptoms. His point as regards the usefulness of general treatment in surgical tuberculosis of the joints, etc., is well taken, but by no means new. Although the sanatorium system has given good results, and is hoped to give still better results, yet there has been of late some scepticism regarding the whole sanatorium movement. The change from the favorable conditions of the sanatorium to the misery of the patient's home is often forgotten, and the effect of the change from the leisure of the sanatorium to hard work in the patient's accustomed surroundings is frequently lost sight of. There is a field for home treatment, inasmuch as it is impossible to admit into the sanatorium either the surgical cases or the very far advanced cases. The home treatment should therefore be studied and developed as perfectly as possible.

In speaking of the means that prove of value in home treatment, the author emphasizes the usefulness of increasing the activity of the skin. Locally this was formerly done in tuberculosis of the joints with vesication, *moxæ*, and other painful methods. General cutaneous activity may be promoted best by means of lukewarm baths and sponging, as well as by methodical rubbing with soft soap before the bath. This method, which the author has employed for twenty years with good results, was first introduced by O. Kapesser of Darmstadt. The author uses a soft white alkaline soap, not the "green soap," which is too irritating. The patient rubs his whole body three times a week with this soap applied with a flannel rag or a sponge, with the addition of a little water. The patient is then rolled up in a blanket and after half an hour his body is washed with lukewarm water in a bath, or by pouring the water over him from a can. For more fastidious patients he orders "Töltz soap No. 2", or the use of soap spirits applied to the skin with a brush. If the skin is inelastic, he orders a preliminary coating with oil or vaseline. For patients who cannot leave their beds, he orders the use of sponging with lukewarm water with the addition of a little spirits of soap. The patient's diet and mode of life is also looked after. For gargling he employs chiefly salt water; for inhalation the volatile oil of *Pinus pumilionis*, which is mixed with hot water, and the steam inhaled. Massage with a mixture of potassium iodide ointment and soft soap from two to five minutes daily, followed by a lukewarm local bath is useful in tuberculosis of the joints. Passive motion, the use of splints, flannel or knit bandages, or of cold compresses if there is an increased local temperature, may also be of use in these cases. In cases with fistulæ he adds a little bichloride or lysol to the water used in the local baths. In tuberculosis of the spine, corsets that can be easily removed should be preferred, and rubbing with soft soap, etc., should not be neglected in the chronic stage, with ambulant treatment. In tuberculosis of the glands the patients should be sent to the seashore or to a mineral bath, or mineral baths should be given at home, and the other methods of treatment described above should also be employed.

2. Dr. W. Stœckel believes that tuberculosis of the bladder and kidneys occurs more frequently in women than is generally supposed, and that it is often mistaken for other conditions. Gynæcologists are accustomed to attribute all urinary disturbances in women as results of lesions in the uterus or its appendages. The urinary tract is itself often responsible for such disturbances. It must be remembered that tuberculosis of the urinary tract can remain latent for a long while before it gives rise

to serious symptoms, and the diagnosis is especially difficult in cases in which there are few or slight bladder symptoms. It is often very difficult to find tubercle bacilli in the urine of such patients, but of course when they are found, they are pathognomonic. Cystoscopy is the most important method of diagnosis in tuberculosis of the urinary organs. It should not be attempted in acutely inflamed bladders, but the organ must be first placed in as good a condition as possible. The ureteral catheter is not necessary except as a last resort, but in examining the bladder, special attention should be paid to the presence of small greyish tubercles, which are characteristic of vesical tuberculosis. The author believes that all bladder tubercles are derived from descending infection from the kidneys. The objection to using the ureteral catheter is that a healthy ureter may be infected with tubercle bacilli in this way, if the infection happened to descend on one side and had not affected the other kidneys. The trigone and the region of the ureters are first affected in a descending tuberculosis, but if the trigone be found free, the presence of renal tuberculosis should not be excluded, as the first tubercles to appear may heal first and leave no trace. If there are no signs of tuberculosis in the bladder, the ureteral orifice should be carefully examined as it is distorted, inflamed, swollen, etc., if there is a ureteral lesion. By watching the jets of urine from each ureter and noting which one is retarded, and which one is clouded, we can tell which side is affected, and then catheterize that side, leaving the healthy side alone. The treatment of tuberculosis of the bladder should never be operative; that of tuberculosis of the kidneys should always be surgical. The only radical measure that can give good results as regards the prolongation of life is nephrectomy, but this should be never performed unless there is proof that the other kidney is healthy.

The reviewer must call attention to the fact that Stœckel's mode of looking at catheterization of the ureters in tuberculosis of the bladder and kidneys is not shared by the majority of observers who have had an extensive experience with such cases. The author himself admits the impossibility of being sure that the opposite kidney is healthy without catheterizing it and also the irrationality of removing the diseased kidney without knowing that the other kidney is healthy enough to sustain life. Yet, he insists on either omitting ureteral catheterism or performing it only on the side which by cystoscopy has been shown to be the diseased one. We could go on arguing this question at some length, but no cases of tuberculous infection of a kidney by means of a ureteral catheter have been recorded, and there are certainly cases in which it becomes necessary to catheterize both ureters before an operation is to be thought of. The emphasis of the author, on cystoscopy as the most trustworthy method of examination, far more so than the examination of the urine, for example, is well placed.

3. The observation reported by Dr. Fischer, on the healing of large pulmonary cavities, is of considerable interest, as it throws some light upon the pathology of the healing process in tuberculosis of the lungs. The author reports the case of a man aged forty-one years who had pulmonary tuberculosis, tertiary syphilis, alcoholism, and chronic nephritis—certainly not a favorable combination. On autopsy, his left lower lobe contained a hæmorrhagic infarct, and the branches of the pulmonary artery which went to this lobe were closed by thrombi. The remainder of the left lung was not affected. On the right side the apex contained a large cavity of the size of a walnut, which was almost completely contracted through a growth of scar

tissue; the cavity was smooth and contained air. The rest of the upper lobe was consolidated and contained only connective tissue. A large thrombus was found in the main stem of the right pulmonary artery; this thrombus was found to be continuous with thrombi running into all the arteries supplying the right upper lobe. This is a case in which there has been a marked advance towards the perfect healing of a cavity, for the latter must have originally occupied almost the entire upper right lobe, and the author believes that there was a direct connection between the healing of the cavity and the occlusion of the pulmonary artery. The proof of this influence of the pulmonary artery cannot be furnished in this case, as it is impossible to say just how the healing was favored by circulatory changes, but it is possible that new connective tissue formation went on in the area supplied by the thrombosed artery in the same way as it does in the case of a hæmorrhagic infarct into a tuberculous lung.

4. The last article in the present volume is a statistical study of the frequency of tuberculosis elsewhere in the body in the cases of lupus and scrofuloderma by Dr. Grouven. In 1886 Bender published data which tended to show that tuberculosis was very frequent in other organs in cases of lupus. Out of 189 cases of lupus there were 109 with a history or symptoms of tuberculosis in other organs. Bender's statistics prove that phthisis is more common in patients with lupus than in other persons, and therefore it seemed important to confirm or deny this statement on the basis of a study of the material offered in the clinic at Bonn since Bender's time. The entire material of the dermatological clinics at Bonn from October 1, 1885, to April, 1902, included 1130 cases of scrofuloderma and lupus. Of these, 368 out-patients, whose records were incomplete, could not be used for a statistical study. Of the 178 available cases from the out-patient department, there were 136 cases with lupus (48 men and 88 women), 25 cases of scrofuloderma (12 men and 13 women) and 17 cases of lupus and scrofuloderma (8 men and 9 women). In these 178 cases a tuberculous heredity or tuberculosis elsewhere in the patient or his nearest kin was found in 8 men (11.72 per cent.), 21 women (19 per cent.), total 29 cases (16.3 per cent.). Heredity alone was found in 14 men and 23 women—37 cases or 20.8 per cent. Tuberculosis elsewhere in 36 men and 57 women—93 cases or 52.25 per cent. Neither heredity nor tuberculosis elsewhere in 10 men and 9 women—19 cases or 10.68 per cent. Hence there was either heredity or tuberculosis elsewhere in 85.3 per cent. of all men, 93.8 per cent. of all women—80.32 per cent. of all cases. A further analysis of the remaining cases treated in the hospital, showed that lupus of the mucous membranes is more often combined with tuberculosis elsewhere than lupus of the skin. The figures collected by the author are stronger in favor of the tuberculous nature of lupus than any other statistics previously published. He mentions in passing, the fact that in all patients with lupus who came to the autopsy table at Bonn, there were tuberculous lesions found elsewhere in the body. The tuberculous nature of lupus has been fairly well established by numerous studies, but the antagonists of this view have always claimed that it is impossible to produce lupus by inoculating tubercle bacilli into the skin. It is important, therefore, to establish the relation between lupus and general tuberculosis, and between lupus and scrofuloderma.

TUBERCULOSIS. Recast from the Lectures Delivered at Rush Medical College in Affiliation with the University of Chicago. By Norman Bridge, A. M., M. D.,

Emeritus Professor of Medicine in Rush Medical College, etc. 8 vo. pp. 302, illustrated. Philadelphia, W. B. Saunders & Co., 1903.

As indicated in the title, this book is an elementary treatise on pulmonary tuberculosis, incorporating the subject matter of lectures by the author at Rush Medical College, Chicago.

Dr. Bridge reviews very broadly the various phases of the tuberculosis question, as it is looked upon to-day by the majority of the profession, and enough is given to enable the student to gain a general knowledge of the disease under consideration.

The author describes eight clinical varieties of pulmonary tuberculosis which are mostly based upon the degree of fibroid changes that may have attained in the lungs, a division which we fear will prove rather confusing than helpful, and which the author has himself failed to utilize in the practical portion of his work.

The sections on physical signs, diagnosis and treatment, are the more satisfactory and important, as they reflect the author's personal observations from a large practical experience, and from which not only the college students, but also the practicing physician can gather much that will prove of value.

In dealing with serum and tuberculin, as special modes of treatment, Dr. Bridge shows fairness and impartiality, which is the more to be commended, inasmuch as he himself, seems rather sceptical. He appears to have overlooked numerous experimental and clinical researches which have been made during more recent years on the value of tuberculin and its modification. Especially the comparative results reported by Weicher, Möeller, and Kayserling and others, appear to have escaped his attention, for he seems to hope for just such comparative results for the demonstration of the aid that these preparations can give in practice.

The book will serve a useful purpose to all those who have not the time or the inclination to follow the voluminous literature scattered in the numerous medical periodicals and who nevertheless wish to have something more complete than is supplied by the ordinary medical text book, and to all such we can unhesitatingly commend it.

A SYSTEM OF PHYSIOLOGIC THERAPEUTICS. A Practical Exposition of the Methods, other than Drug-giving, Useful in the Prevention of Disease and in the Treatment of the Sick. Edited by Solomon Solis Cohen, A. M., M. D. Volume V. PROPHYLAXIS—PERSONAL HYGIENE—CIVIC HYGIENE—CARE OF THE SICK. 8vo., pp. xvii, 539, with three colored plates and 120 illustrations in the text. Philadelphia: P. Blakiston's Son & Company, 1903.

The fifth volume of the series of manuals on physiologic therapeutics, edited by Dr. Solis Cohen, of Philadelphia, embraces a wide range of subjects that may be grouped under the broad term prophylaxis. As the editor says in the preface, it is a sign of the times that a system of therapeutics should include a volume on the prevention of disease which is no longer dissociated from treatment.

The volume before us begins with an epitome of the causes of disease, followed by a section on the general theory of prevention, including the natural defences, (immunity, etc.), and the artificial defenses, such as asepsis, antiseptics, disinfection, the prevention of infection through animals, and the special prophyl-

laxis of the communicable diseases. This section is in charge of Dr. Joseph McFarland and Dr. W. Wayne Babcock, both of Philadelphia, and occupies rather more than half the volume. The second section, devoted to civic hygiene, is in charge of Dr. Henry Leffmann, of Philadelphia, and includes such topics as the general hygiene of cities, streets, buildings, the sanitary organization of cities, the hygiene of food-supply, water-supply, the disposal of waste, and disposal of the dead. The third section, in charge of Dr. Albert Abrams, of San Francisco, treats of the hygiene of dwellings, of schools, of travel, personal hygiene, and includes chapters on the sick room, the care of patients, and the technique of operative nursing.

As we see, the volume is comprehensive in scope. To crowd all these subjects into an octavo of about five hundred pages involves condensation, epitomization, with a consequent scantiness of elaboration, and omission of all discussion. When we remember that the contents of this little volume embraces the topics included in the great "*Handbuch der Prophylaxe*," published in Germany, in which a volume is devoted to almost every one of these topics, we realize that what has been aimed at in the present manual is rather a bird's-eye view of the subject of prophylaxis, than a minute exposition of the themes considered. In its arrangement, as well as in the care bestowed in eliminating unessential details, and in bringing forward fundamental facts and principles, this book is to be commended; and one who is looking for a rapid review of the subjects treated of, as a basis for a broad understanding of the aims and achievements of modern prophylaxis, will find what he wants here; one who is looking for a critical examination of scientific evidence, for a review of the literature of the subjects in hand, for a discussion of moot points, will be disappointed. Necessarily this mode of treatment, appropriate as it is in manuals of this sort, frequently means a one-sided treatment of theoretical questions, and a dogmatic outline of the practical side of the prevention of disease. Witness, for example, the manner in which the important question as to the relation of bovine to human tuberculosis is treated. The conclusions of Koch, set before the London Tuberculosis Congress, are characterized as "hasty assertions;" a brief summary of the "positive" side of the question is given, including reference to the work of Ravenel and others, but nothing is said of the experimental evidence accumulating against the "positive" side and in favor of Koch's "theory." A disputed question of this kind is disposed of in accordance with the editor's own views, in a few words. We fear, if this plan has been pursued throughout the book, many statements therein will have to be reversed within the next five years in a new edition. On the whole, a great deal of care and judgment has been evidently employed in selecting the material admitted to the pages of this book. Occasional lapses from this policy occur; such as, for example, the admission of two intricate mathematical formulæ showing the relation of the lesions of tuberculosis to the virulence of the germ and the resistance of the body, etc., on page 251. Nothing is said about the various kinds of tuberculins and similar immunizing products; but, presumably, this will be included in the last volume of the series, dealing with serum-therapy. In speaking of the immunity of the Jews against tuberculosis, their advantages over other races are attributed to the observance of certain religious rites, and the adherence to certain dietetic

laws, whereas it has been shown quite conclusively that their comparative immunity is due (Reibmayr, and others) to the fact that their race has been tuberculized through centuries of morbidity, and that the acquired immunity in them has been strengthened by inbreeding. In a few places repetitions are noted, that may be necessary through the overlapping of some subjects, but this does not detract from the value of the book; it rather makes it easier of reference. The language, it may be added, is on the whole clear and concise, though occasionally a streak of rarely-used words, and neologisms, runs through the text, as for example: "emenated" instead of changed or altered; "environmental," "strenuosity," and the hybrid: "toxiferous."

To sum up, the volume before us will be found of special value to the general practitioner; particularly to the one who has fallen behind the movements of modern medical science in the routine of his daily practice. It will be undoubtedly of great help also to the undergraduate student. To the advanced student and to the writer and investigator it can only serve as an epitome.

ARZT CONTRA BAKTERIOLOGIE. Von Professor Dr. O. Rosenbach, Berlin. 8 vo. pp. x—278. Berlin. Urban and Schwarzenberg, 1903.

The appearance of such books as that of Professor Rosenbach is almost a necessary phenomenon in the evolution of medicine, a healthy, physiological manifestation, and for this reason all those who are interested in the progress of the healing art may calmly accept it as nature accepts reversions to ancestral types, and other occasional backward steps in the onward movement of things and thoughts.

To characterize the author's ideas as heresy, would not be in conformance with the spirit of science which to-day insists upon the widest freedom of thought and the most liberal application of the principle of *audiat et alia pars*. To speak of the book as cant, would be entirely false; for whatever may be the author's sins of commissions or omissions, in the pursuit of his theme, a conviction seizes one on reading his work that he is sincere in his views and thoroughly imbued with the idea that they are the only true views on the subject.

The purpose of this book is to give in a collected form a series of articles which the author contributed to various journals, or which formed portions of various works from his pen, bearing upon the controversy that is denoted by the title, the imaginary suit-at-law docketed: "Physician vs. Bacteriologist." Luckily for the reader, the evidence for the plaintiff, presumably the physician, occupies only 278 in octavo pages of moderately large type, and is not, like the evidence in *Jarndyce vs. Jarndyce*, contained in tomes upon tomes of musty calf-bound digests of the High Court of Chancery. So with brave heart, and an unsatiable thirst for truth, one can safely venture into the paths of thought laid out by the author.

In order to give a complete summary of the author's views on the various subjects which he discusses, we would have to occupy more space than is at our command. The collection of papers is, moreover, neither systematically arranged, nor written with a unity of design, so that the book contains a number of more or less fragmentary and disjointed essays which are difficult to review as a whole. In substance, however, the book is intended to prove that bacteriology is the worst enemy of the physician, instead of his most faithful servant, that the exper-

imental data upon which the theories of infection and artificial immunity rest are irrelevant testimony on account of the differences between the organisms of lower animals and that of man, and between the conditions of experimentation and natural infection. In addition, the author tries to show that the modern movement in therapeutics, which seeks to utilize specific antitoxic and antibacterial agents in the treatment of disease, is a mere fad which will be short-lived and die an ignominious death, as many other fads in medicine have.

These views, we see, are extreme in their opposition to the accepted ideas which the author characterizes as "dogmas." And yet, there are many utterances in this book that those who occupy the middle ground will agree with, recognizing the achievements of bacteriology and serum-therapy, but aware of their limitations; for example, the fact that experiments upon animals are not always conclusive as to the effect of infection or immunity upon man, and that laboratory experiments are usually conducted under conditions which are certainly widely different from those which obtain in nature. Thus the inoculation of a cow with enormous amounts of sputum cannot be the reproduction of a series of events that could possibly happen in the ordinary conditions of a cow's life.

On the other hand, in his attacks upon serum-therapy, especially diphtheria antitoxin, and in his denunciation of Koch's work with the tuberculin products, the author follows blindly where his own prejudice leads him. The papers on tuberculin were, it is true, written in 1891, when the "scare" which followed Virchow's unfavorable attitude towards Koch's first product was at its height. To-day, in justice to Koch and his followers, the author could not have written what he did in 1891, if he had conscientiously studied the literature of the subject; certainly not if he himself had applied tuberculin in the proper manner in his practical work. And yet, he is in agreement with the consensus of authority to-day when he says (p. 94), "that the untoward effects of Koch's tuberculin should not be attributed to the remedy itself, but to the improper application and dosage thereof." The only other paper in this book which has a special bearing upon tuberculosis is the last one, entitled, "Remarks on the Pathogenesis of Tuberculosis." In this article the author calls attention to the diagnostic and prognostic value of a symptom of phthisis which he described in a previous publication. He refers to the peculiar odor of the breath, noticeable in consumptives, and says that it is so characteristic that a person with such an odor should be suspected of having consumption, and should be examined at intervals. In most cases physical signs will appear in the lungs of such persons. The author thinks that to prevent consumption it is well to keep the mouth and teeth in good condition, and points out that in phthisical patients the hygienic condition of the mouth often leaves a great deal to be desired. He does not admit the specific nature of the tubercle bacillus nor its primary etiologic significance in the development of tuberculosis, but does admit that the pyogenic germs play an important rôle in the production of the disease, either alone or in virtue of a symbiosis with the tubercle bacillus. The odor of the consumptive's breath has been a matter of comment by older writers on the subject, and is not a new clinical sign. Its value from a diagnostic viewpoint may be judged when we remember the variety of factors that may produce and alter the odor of an exhalation. As regards its prognostic value, it is well that the clinician does not have to depend upon such uncertain signs for his

prognosis in tuberculous patients, and we do not think the author is justified in saying that when this odor occurs the patient is doomed, when in the very next sentence (p. 273) he admits that the patients with the least amount of pulmonary lesions show the most distinct odor in their breaths.

On the whole, we think that the book would make profitable reading to one who is thoroughly acquainted with bacteriology, serum-therapy and experimental pathology, inasmuch as it presents many moot questions from the viewpoint of the extreme opposition; but to one who is not so well informed as regards the actual state of science in these matters, its perusal would give ideas that may bias his judgment and would only tend to confuse him in his conceptions of etiology and therapeutics. The book, like some of the therapeutic agents with which it deals, is harmless, if properly applied.

INTERNATIONAL MEDICAL ANNUAL. A Year-book of Treatment and Practitioner's Index. 1903. Twenty-first Year. New York: E. B. Treat & Co. 1903. Price \$3.

The practitioner will find the new volume of the International Annual series a most useful manual of reference in questions of diagnosis and treatment as they are viewed in the latest literature. The articles are necessarily brief and do not attempt to treat the various subjects exhaustively, but in each instance enough is given to enable the practical man to apply new therapeutic or nosologic facts in his daily work, and to give him a hint as to the current of progress of medicine during the past year. For a student, a worker in a special field, a writer, or an investigator, this Manual would not have as much value, inasmuch as it does not pretend to cover the literature of the subjects treated, nor to give a critical and detailed consideration of debated questions. On the other hand, the book should be found, not on the shelf, but on the desk of every man whose time is limited, whose opportunities for reading are few, and who would like to keep moderately well abreast of the times.

The article on phthisis is under the editorial charge of Dr. H. P. Loomis, of New York, who gives a brief, but sufficiently full review of the various advances in the treatment of tuberculosis during the past year. The article on sanatorium treatment is under the charge of Dr. T. N. Kelynack, with an appendix by Dr. H. P. Loomis. In both only general conclusions are dealt with, and the value of sanatoria for consumptives is strongly emphasized. These articles may be regarded as fairly representative of the current opinions on the subject of sanatoria, and may, therefore, be commended to the general practitioner as summaries of a great deal of discussion and study which has been going on in this field during the year.

MANUAL OF INTERNATIONAL CLASSIFICATION OF CAUSES OF DEATH. Adopted by the United States Census Office for the Compilation of Mortality Statistics for Use Beginning the Year 1900. Prepared under the supervision of Wm. A. King, Chief Statistician for Vital Statistics. Government Printing Office, Washington, 1902.

In order to secure a uniform system of recording the causes of death in the various states of the Union, so as to render possible the collection, tabulation,

and annual publication of the vital statistics of this country, the United States Census office has adopted a system of recording causes of death, which it recommends for adoption by the different states, and municipal Boards of Health. Under the system of decentralization which is based upon the doctrine of States' rights implied, as well as distinctly uttered, in our Constitution, each State has the privilege of conducting its own vital statistics in any way it pleases. Hence all the Census Office can do to secure such needed uniformity is to issue a scheme of causes of death, properly classified, and to ask that in future the different states conform to this system. This is the primary purpose of the manual under review. With it we have also received sample copies of circulars of instruction issued by the Census Office to physicians, medical colleges, registrars of vital statistics, etc.

The need of a uniform system of registering vital statistics in the various states becomes at once apparent when one realizes that it is impossible for the national Census Bureau to collect and properly collate data on mortality if there is no uniformity in certifying and recording the causes of death. Not only is a uniformity, so far as possible, desirable in the nomenclature of diseases, but also in the form of death certificate employed in the various parts of the country. A form has been adopted for this purpose by the Census Bureau and is sent out to registrars everywhere. Physicians are urged to familiarize themselves with the system of causes of death, so as to conform to it in their certificates of death, so far as nomenclature of diseases is concerned. Medical schools should instruct students in the principles of vital statistics and should emphasize the necessity of care, accuracy and uniformity in writing certificates of death. Such is the general purpose of the publications from the census office; they have been compiled with a great deal of care and are the result of an enormous amount of labor, for which the director of Vital Statistics certainly deserves full credit. The system of the causes of death adopted by the Census Office is herein detailed in the form of a voluminous index giving the causes alphabetically in all the possible variations of nomenclature. It is based upon the system recommended by Bertillon at the International Statistical Conference in Chicago in 1893, since then modified in 1900, under the auspices of the International Congress of Hygiene and Demography in Paris. Its adoption has been recommended by the American Public Health Association for this country, Canada and Mexico, and by the International Conference of State and Provincial Boards of Health. The present index of causes of death is virtually a translation of the official French version adopted at the Congress in Paris in 1900.

TRANSACTIONS OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION FOR THE YEAR 1902. Volume XVIII. 8 vo, pp. liii-270, with illustrations. Philadelphia. Printed for the Association. 1902.

The eighteenth volume of the Transactions of the American Climatological Association presents in detail the work of this body for the year 1902. Following the lists of officers and members, the minutes, an obituary of Dr. Eskridge, and a description of the tour of the Association through Kansas, Colorado, New Mexico, Arizona, California, and Utah, there are presented in this volume twenty-two papers on climatology and pulmonary diseases. While all the papers are replete with

interest, some of them may be given brief mention here, owing to the fact that they treat of disputed questions in the field of tuberculosis.

In an essay entitled, "Comparative Studies of the Tubercle Bacilli and their Importance in Relation to Tuberculosis in Man," Dr. E. A. DeSchweinitz, of Washington, D. C., emphasizes the effect of environment upon the virulence and morphology of the tubercle bacillus, supporting his statements by experimental data. Unfortunately, possibly through a mistake on the part of the printer, or binder, our copy of the Transactions does not contain the plates to which this author refers in his text. He inoculated three sets of flasks of the same culture-media with three varieties of human, bovine, swine, horse, avian, and dog tubercle bacilli, and found that there was almost uniformly an increase in the size of these various germs, depending upon the length of time that they had been allowed to develop upon artificial media. A similar morphological difference was noted also between the germs obtained from different organs of the same animal. It is easy to understand, therefore, how the virulence of germs obtained from different animals might vary, if the morphology changes so easily. A chemical study of the bodies of tubercle bacilli from different animals showed that there is a considerable difference in the amount of soluble matter in these different germs, but the human bacilli seemed most closely related to those of bovine tuberculosis. In speaking of the theories advanced by Koch, regarding the non-communicability of bovine tuberculosis to man, the author characterizes them as "perfectly unwarranted," and cites a number of experimental findings by Ravenel and others in support of his view. Monkeys are the species of animals most closely related to man, as is proved, not only by the morphology of anthropoid apes, but also by the recent work with the blood-reactions (precipitins) of man and monkeys. Inasmuch as direct inoculations of bovine tuberculosis into man are impossible, we should content ourselves with experiments on monkeys which give positive results with such inoculation. In speaking of certain modern methods of treating tuberculosis, the author calls attention to the fact that a chemical study of the bodies of the bacilli proves that they utilize substances essential to life in their growth upon the human organism; for they contain fats, waxes, fatty acids, nucleoproteids, probably lecithin, glycogen, and other products. The use of lecithin and of nuclein therefore seems rational to the author.

Dr. Charles Denison, of Denver, Colorado, contributes a paper on "Intrathoracic Pressure," in which he reviews the various influences of modified intrathoracic pressure in the treatment of tuberculosis of the lungs, and describes a method of immobilizing the lung when it is necessary to give rest to the pulmonary tissues. A large portion of this paper is devoted to a criticism of Dr. Norman Bridge's article, "The Proper Management of the Tuberculous Lung," (Journal Amer. Med. Ass'n. Vol. xxxviii, 1902, p. 21). In contrast to Dr. Bridge, the author condemns the policy of "do-nothing," which so long has predominated in the management of tuberculous patients in climatic resorts. The author emphasizes the benefits and the need of lung-expansion; provided, areas affected are given the proper amount of rest, so as to secure their healing. Thus, if one lung is well the diseased side should be immobilized. If there are cavities that bleed the diseased area should be protected from motion. Dr. Bridge is opposed to systematic exer-

cise, to lung-exercises, such as breathing against resistance, and favors the immobilization of the lung, if practised, by means of inflating the pleural cavity with gas according to Murphy. The author recommends the use of wide strips of mole-skin adhesive plaster, cut in a special manner and attached to a muslin collar which supports the dressing, acting like a harness.

The article on the "Action of Strychnia on the Heart and the Evil of Overdosage," by Dr. Roland G. Curtin, does not strictly treat of pulmonary tuberculosis, but is noticed here on account of the relativity of the author's remarks in the care of consumptives with deficient cardiac functions. The author dwells on the evils of administering large doses of strychnia as a heart-stimulant in chronic conditions, and quotes Sansom, of London, as saying, that "strychnia in large doses is of no benefit to the heart and will not assist it, when in a crippled condition, to do its work." At times, in patients with an idiosyncrasy, large doses of strychnia produce toxic effects, e. g., muscular contractions. To illustrate the irrational administration of strychnia as a continuous heart stimulant the author uses the following simile: "A horse is encouraged to pull a heavy load to the top of a hill by sharp applications of the whip. At the top of the hill, however, the animal must rest; and the driver knows, that if he keeps on applying the whip and straining the horse, the animal will exhaust its strength. We can imagine a similar condition of affairs when the heart is stimulated to the limit with strychnia; it cannot rest, but must go on." Instead of strychnia the author employs with preference as heart stimulants digitalis and alcohol, nitroglycerine, caffeine citrate, cactus grandiflora, strophantus, ammonia and atropine. He has never seen a case of marked cardiac depression in an elderly person in which large doses of strychnia were given and the patient survived.

Dr. Guy Hinsdale, of Philadelphia, presents a paper on the "Climatic and Health Resorts of the Dominion of Canada," which is full of interesting data concerning regions that are comparatively unknown to the American medical profession. He dwells especially on the pleasures and limitations of out-door life, camping, etc., in the Canadian provinces, and gives much valuable information to those who contemplate a trip of this kind, or who are consulted by patients in regard to the climatic conditions prevailing in Canada at different seasons.

"Altitude in Fact and Fancy" is the title of an interesting paper by Dr. Henry Sewell, of Denver, Colorado, in which he calls attention to the necessity of a further, thorough study of the physiological and pathological effects of altitudes upon the human organism, and expresses the hope that an endowment may be soon contributed for this purpose. The question as to the physical and psychical effects of high altitudes has not been sufficiently well studied, and the laity, as well as a portion of the profession, hold distorted notions on the subject. "When the physiological effects of climate are better understood, the climatic treatment of *disease* will give way to the climatic treatment of the *patient*, and our advice will be more definitely founded on the effects upon individual metabolism of the various meteorologic conditions available to us. No climate is a specific against any disease, but can only aid in its cure by facilitating in one direction or another the sum of the nutritional processes of the body."

THE AM. CONGRESS ON TUBERCULOSIS.

NOTICE TO THE PROFESSION.

At a conference of the officers and Advisory Committee of the American Congress on Tuberculosis, held in New Orleans, May 7, some important changes were made in the plans as previously announced.

The previous plans of the Council to hold the Congress in St. Louis, in 1904, were changed, many considerations favoring Washington, D. C., as the place of meeting. A change of time of meeting was also made to April 4th, 5th, and 6th, 1905.

As there is to be an International Congress on Tuberculosis, in Paris, in 1904, it was deemed possible that some foreign delegates might be prevented from attending the Washington meeting on that account. The plan and scope of the American Congress being in reality international, the postponement of the meeting to the Spring of 1905 will give the management ample time for perfecting details upon which the success of a Congress largely depends.

One committee has been already arranged to have charge of the Section of Pathology and Bacteriology, as follows: Dr. Simon Flexner, chairman; Dr. William H. Welch, Dr. George J. Adami, Dr. Theobald Smith, and Dr. F. F. Westbrook. Committees in charge of other sections or departments will be announced later.

Dr. George Brown of Atlanta, Ga., is practically the Executive Officer of the Congress, and all who desire to present papers before the Congress should apply to him. As there seems still to be a doubt in the minds of many physicians concerning the result of the vote of the New York meeting, which in 1902 adopted a new and definite plan for the next Congress, we beg to assure our readers that the new plan is being followed in both letter and spirit by Dr. Brown and the other officers elected at that meeting.

Any circulars or communications purporting to be in the interests of the American Congress on Tuberculosis, which do not appear over the name of Dr. George Brown, as Secretary, do not relate to the Congress which was arranged last year, and the organization of which has already so far advanced as to insure its success from every point of view.

DANIEL LEWIS, M. D.,

President, The American Congress on Tuberculosis.

ORIGINAL CONTRIBUTIONS.

THE FLOATING SANATORIUM FOR PULMONARY TUBERCULOSIS.

BY DR. FRANZ MICHAEL, AND DR. HERMANN MAURER, BERLIN.

Sea voyages have, for many years past, been recommended to patients with consumption as a means of regaining their health. Trips upon sailing vessels or steamers have been advised in the hope that a prolonged sojourn in the sea air would be beneficial to these patients. A great deal has been expected of the freedom from microbes which characterizes sea air and the increased appetite and improved metabolism which result from a sojourn on the sea. And yet the results of this method of treatment have been in no way proportional to the expectations.

The chief trouble has been that there were no proper ships adapted for the reception of consumptives, and that the life of healthy people and of consumptives in the narrow quarters of ordinary sea-going vessels is dangerous to both classes. The former can be easily infected and the latter forget only too easily the purpose of their voyage, the regaining of health, and indulge too frequently in amusements which are injurious in their condition.

Other important faults that must be mentioned in connection with long sea voyages, are the unavoidable monotony in the food, the insufficient ventilation of the narrow staterooms, the dangers of infectious diseases in tropical harbors, and finally the treacherousness of the sea. In the case of steamers, there is added the great disadvantage of smoke from the machines, as well as of the smell of oil which pervades their interior, and also of the extraordinary speed of these vessels, which is very useful otherwise, but which renders sea voyages very expensive for tuberculous patients.

For these reasons, sailing vessels have been used more extensively by patients, than steamers; and especially during the winter months, many of these ships carry a number of consumptives on board, for the most part bound for Australia and South America. But even sailing vessels have disadvantages. The slow voyage and the dependence of the ship upon the weather cause difficulties in the supply of provisions, and necessitates isolation of those on board from the rest of the world for considerable periods. Besides, the living quarters are as a rule insufficient,

because such ships are intended principally for the carrying of merchandise, which in turn frequently contains infectious or injurious substances.

All these considerations suggest the idea that a floating sanatorium might be built, which would correspond to all the requirements of health, and would be intended for consumptives only. In this manner the curative qualities of sea air and its beneficial effects upon catarrhs of the respiratory tract could be utilized. Moreover, the important hygienic and dietetic measures which are so necessary in the treatment of tuberculosis could be applied on such a ship under strict medical supervision and with the attention to the special needs of the individual, which is so necessary to success.

These considerations, after a thorough study of the subject, have brought the authors to the elaboration of a plan for such a floating sanatorium, which they have drawn with the aid of an engineer of the Hamburg-American Steamship Line, Mr. Gatjens, of Hamburg. The latter, after having studied ship hygiene and the construction of sanatoria in detail, has drawn the actual working plans of such a ship and has submitted them to the authors.

The principal features of this floating sanatorium may be described, with the proviso that all the rights of the originator of the plan have been strictly preserved. The ship selected was a sailing vessel, because it was desired to do away with the smoke nuisance of a steamer. Besides, the purpose of the sanatorium-ship is not speed, but simply enough motion for an agreeable sea voyage. An auxiliary engine, however, has been installed in the after-part, in order to enable the ship to proceed in a calm, or to assist it in manœuvering in and out of a harbor. The rig of the ship is that of a three-masted schooner. It is constructed of steel, not only in order to reduce the crew to a minimum, but also in order to render most of the deck free and accessible to the passengers. Four watertight partitions divide the craft into five water-tight compartments. The relation of beam to length is ample, so that the ship leans but very little when under way, and so that it does not roll or pitch much. The sail-area is normal, but not excessive, because the purpose of the ship is not to develop extraordinary speed.

A great deal of care has been devoted to the arrangement of the deck in order to provide a comfortable place where the patients can remain in the open air in all kinds of weather. For this purpose, a large pavilion has been provided amidships, in which the patients can take the "rest

cure." On either side of this pavilion are narrow promenade-decks, and awnings are stretched over the entire ship, wherever possible. The deck-pavilion is built of iron, and the deck over it, as well as the upper deck, of teak wood. The pavilion is constructed inside without any decorative mouldings, so that the walls, etc., are perfectly smooth. These walls are painted in oil and decorated only with a few small framed pictures. The floor is of terra-cotta tiles. The tables are of marble; the chairs and seats covered with leather. The upper deck has a height of two metres, forward and aft, the bridge or passenger deck a height of 2.7 metres. On the passenger deck, also amidships, are the staterooms of the patients. Aft are the staterooms of the captain, physician, mates, machinists, etc., while forward are the quarters of the sailors, boatswains, and nurses. In this manner the patients are quartered entirely separately from the ship's crew and officers, and all three classes have their own companion-ways from the deck. There are staterooms for about forty patients. The walls of these staterooms are made of pine frame, and the same material is used for the ceilings. Walls and ceilings are lined with zinc sheeting and the latter is so arranged that the corners are rounded. The floor is covered with an impervious material which is also arranged so that the transition from the floor to the wall is rounded throughout. Walls and ceilings are painted with oil paint. The furnishings are substantial but very simple, and among other things the patients are provided with swinging iron cots, and wash-stands with cold and hot water supply. Staterooms are arranged to accommodate from one to two persons each, and in all cases they are sufficiently roomy and well ventilated. A small, but well ventilated "ward," is provided for fever patients and for other serious cases, and in the adjoining rooms are the pharmacy, the laboratory, and the consultation-room of the physician.

The dining saloon seats forty-eight persons. The walls and ceilings are of wood, perfectly smooth, without any decorations, and the floors are finished in the same way as in the staterooms. Baths and shower-baths, as well as water closets, are provided for the passengers. They are constructed of wood, with marble tilings, and are situated forward and aft.

The outer staterooms each have two port-holes with dead-lights of 12 cm. diameter. The inner staterooms have skylights of sufficient size. Wherever possible, rooms which adjoin a corridor are provided with ventilators or valves. The passenger deck is provided with six ventilators of large size, each of half a metre diameter. A sufficient number of venti-

lators is provided for the other cabins. Every stateroom occupied by passengers, officers, or machinists has an electric ventilator. Two large electric ventilators are also provided under the ceiling of the saloon. One kitchen is provided for both passengers and crew and the smoke is led into the hollow steel mizzen mast. All the rooms are lit by electricity, generated by a petroleum motor and dynamo, and in order not to drive the motor at night a large storage-battery has been provided. A refrigerating machine, also driven by a petroleum motor, has also been set up in the machine-hold. A water closet pump can be connected with one of the petroleum motors, according to need, to fill the closet tank, and also the appliances for flushing the deck. The fresh-water tank has a capacity of ten tons, has double walls, and is built into the ship. The necessary life-boats, etc., are provided.

This floating sanatorium, therefore, corresponds to all the modern requirements of hygiene. It remains only to determine the most favorable cruising-ground for this ship; in other words, in what sea we can get the most favorable climatic conditions for a successful treatment, and in what waters we will find the conditions of wind and sea such that the passengers will be least exposed to unpleasant weather. In order to decide this, the authors have consulted a number of experienced seamen. As a result of these consultations, and of their own meteorological studies, they arrived at the following conclusions: In the first place, the northern seas, as well as the torrid zones, must be excluded. The Mediterranean, with the exception of a few stretches along the Riviera of Italy and France, cannot be considered, because the weather is far too changeable on this sea, and there are frequently very severe storms upon it. Another restriction which had to be drawn, was that the cruising-ground should not be too far from the coast of Europe, so that patients could reach home easily, provisions could be renewed without difficulty, and communication kept up by mail, the latter being especially necessary for the comfort of the patients. Under these conditions, the North East Sea offers the most favorable cruising-ground. Every one who has cruised in these waters knows what a wonderful effect such a trip has upon both body and mind. It offers in the highest degree all the advantages that are found anywhere in a sea climate. The temperature is often uniform day and night, and even in July it averages only about 25° C. The heat is scarcely felt in summer, for there is a steady northeast breeze which provides an agreeable coolness that is most refreshing to the patient. The

amount of moisture in the air does not vary, except very slightly. Rains are rare, and the weather is, in general, good almost without any exception. The sea is always slightly rolling, and the ship moves with an easy rocking motion. The winds in these waters are so steady that one can predict the weather for many weeks ahead. Storms are very rare indeed and sea-sickness is seldom observed. The best cruising-ground for our floating sanatorium is the "Passat" of the North East Sea. The trip may begin at Funchal, on the Madeiras. Excellent mail steamers carry the prospective patients from and to this harbor. Those who do not care to undertake a long sea voyage can go to Lisbon by rail and from there in about two days' sail to the Madeiras. From Madeira the sail will be to the Canary Islands, where a stop will be made if necessary, in order to enable the patients to walk through this beautiful region, under the direction of the physicians, and to give an opportunity for replenishing the stock of provisions. Although it is sometimes difficult to obtain provisions in Madeira, one finds at Gran Canaria and Teneriffe the most delicious fresh milk, butter, meat, poultry, etc. If wind and weather are favorable, the ship can then proceed to the Cape Verde Islands, but not along the waters between these and the African mainland, for there it might meet the dusty and hot desert-wind, which would be extremely disagreeable. The course may be directed, however, further out, towards the Lesser Antilles. The ship should never remain too long in any harbor, so that the patients may not be tempted to go on land and to indulge in dissipation, thus injuring their chances for recovery.

The treatment should consist principally in the usual hygienic and dietetic measures, and special attention should be given to the "rest cure," which will naturally be readily indulged in, owing to the surroundings of a ship. Care should be taken, however, to see that the patients take enough exercise by occasional walks on land, as has already been mentioned above. It may be noted that patients can be controlled medically much more successfully and that their mode of life can be more closely supervised on board ship than in a sanatorium on land. The authors think that success would be assured in their floating sanatorium if the project should find the necessary support. The cost of the treatment and the living expenses would not be very much higher than in a private sanatorium on land, namely: from 15 to 20 marks (\$4 to \$5) daily, including everything but wines. The construction of the ship, fully equipped, will cost not over 400,000 marks (\$100,000).

THE VERY EARLIEST MANIFESTATIONS OF PULMONARY TUBERCULOSIS.

BY J. H. TYNDALE, M.D., LINCOLN, NEBRASKA.

There is a German legend concerning a sergeant who inflicted an old war story on his comrades on an average of once a week. When remonstrated with on the all-too-frequent recital, his reply was: "You can not hear this story too often."

The above serves me as an excuse for once more inflicting upon the medical profession my well-worn text in connection with the early recognition of pulmonary tuberculosis: *Examine the individual, not his family history, and rely on the auscultatory find, coupled with the existing degree of anæmia or progressive emaciation, or both, for a diagnosis.*

There is no particular harm in obtaining so-called "confirmatory data," but they are often misleading, besides arguing timidity or ignorance on the part of the observer. It goes without saying, that a diagnosis in advanced cases is readily and easily made. By "advanced cases," I mean such as are recognizable by subjective and objective symptoms pointed out in the text books. These same text books on physical diagnosis are sadly in need of being brought up to date. Anent this matter, Prof. H. D. Didama, of Syracuse, N. Y., in acknowledging receipt of my article on "The Skirmish Line of Incipient Tuberculosis," said in part: "I fear that the majority of practitioners are far behind the diagnostic knowledge, or at least the practical application of it, required by your essay. The lack of auditory acuteness may be an excuse." Amendment accepted. But that is only one more argument in favor of an up-to-date course in physical diagnosis for the present and future generations of medical students.

It is perhaps idle effort to endeavor to instill into the mind of the average practitioner any new ideas on the importance of tone, pitch, rhythm and tempo. When Moses took the children of Israel out of the land of Goshen he allowed a generation to pass and another to grow up before enforcing the ten commandments and other matters of importance. And Moses was wise in his generation.

By what token is the lack of auditory acuteness an excuse for inability to appreciate differences in pitch, for instance? To some extent recognition of pitch and the sense of rhythm are natural gifts. But only to

this extent, that he of a musical temperament will grasp distinctions more quickly and readily than he of limited musical ear. By the way, the ear has nothing to do with it. It is only the road to a receptive brain. Persons without a fine receptive quality should abstain from entering the medical profession. Why does every student take such great pains to develop his sense of touch by palpation of the abdominal and pelvic organs? Why do they train the eye in microscopical research? Why not train the auditory sense?

All excuses for inability to appreciate sound and its diagnostic value brushed aside, let us return to the original text. Auscultation and the general condition, as shown by blood and fat formation, the various degrees of anæmia and emaciation, are the methods of establishing the existence of what was once known as the "pretubercular condition." Here are the reasons:

1. In lung destruction the tubercle bacillus is a mere guest invited by the undernutrition of the host.

2. The tuberculin reaction is, at the present day, scarcely considered available for the diagnosis of human tuberculosis.

3. Thus far the Röntgen rays have added nothing of any special value to older methods of physical exploration, save under the heading of "confirmatory."

4. Râles, rhonchi, with their countless adjectives pointing to their composition and locality, are relegated to the background as concomitant features, not an underlying condition.

In the main, then, diagnosis of tuberculous invasion of the lung is as much dependent upon skill in auscultation as it has ever been. The more pronounced and advanced the invasion, the nearer it becomes a mixed infection; and the greater the destructive processes, the easier the diagnosis. Complete solidification or excavation (cavity) or advanced shrinkage, overlaid or not by an emphysematous patch, call for no particularly fine adjustment in auscultation. The changes in *tonality*—the "quality" of ancient vintage—can be heard by any one with an untrained ear. Incidentally it is always well to remember that bronchial or tubular breathing is present not only in pathological but in physiological conditions as well. In the latter, it is drowned by the low-pitched vesicular or pulmonary breathing.

In the second class of cases, the *less advanced*, the difficulties encountered in auscultation begin to assume proportions. Here the changes

from the normal do not relate to the tonality of pulmonary or bronchial breathing, but only to *changes of pitch* in the former. Of course these warning signs are of value only in connection with an otherwise unaccountable decline in general health, whether that decline be rapidly or slowly progressive.

It is here I wish to ask how many practitioners of the present day are taught, or if they are taught, ever absorb, anything outside of the value of changes in tonality (quality) and the misleading importance of râles? The importance of auscultation does not end but begins with changes in pitch.

That percussion is to follow and never precede auscultation and is to be considered only in the light of a confirmation of the auscultatory finding is mentioned here only because it is too frequently forgotten.

Now to the main question, a question of vastly more importance than the diagnosis and therapeutics of appendicitis plus all of the pelvic organs: How early can we recognize the first beginnings of tuberculous invasion of the pulmonary apparatus? Can any additional signs be elicited by auscultation to fix the locality of the tuberculous invasion indicated by persistent, however slowly progressive, anæmia or emaciation, or both? The answer to the first question is: Just as early as the patient complains of anything, even if it be only getting tired easily. To the second: Quite as readily as in advanced and in temporarily arrested cases.

First of all, do not worry and confuse your mind with the bugbear of heredity. *Keep your attention fixed upon the individual before you*, and do not trouble yourself about his father or his mother-in-law. Hereditary tuberculosis is so rare as to be a negligible factor. It is not proved that tuberculous patients hand down to their children tissues which are especially receptive to tuberculosis.

Placing auscultation at the head of explanatory methods, as I do, you may be astonished to find me saying a good word for inspection; but only to reduce the old methods to simplicity. Inspect for nothing else on earth but the *anatomical sufficiency* of the thorax, which sufficiency should bear some relation to the height of the patient, but not very much. Judge only by an abnormally narrow thorax, or an equally abnormally wide one. The next step suggests itself. By a few deep inspirations (never mind the tape line and the number of inches) ascertain the *physiological sufficiency*. Remember these facts: That a narrow thorax may be capable of unlooked-for expansion, while a large barrel-shaped one may scarcely

move at all—the so-called “fixed thorax.” What you are concerned with is the elasticity of the costal cartilages.

As stated above, one must not expect changes from pulmonary to bronchial breathing in the small beginnings of tuberculous invasion, nor yet marked changes in pitch. Seek for the first auscultatory manifestations of tuberculous invasion *in persistent changes of rhythm*. Inspiration, pause and expiration may singly or in unison be involved. The pathological changes of rhythm are simply the reverse of the physiological, i. e., smoothly flowing audible inspiration converted into an interrupted (staccato) one, a prolonged pause where previously inspiration glided directly over into expiration, displaced by a prolonged and audible one.

The tubercle bacillus is not an accommodating creature and signs no contract to gauge his invasion and the mischief he creates by regular stages from changes of rhythm to raised or lowered pitch and then on to changes of tonality. Then again, resisting power in the human system is largely individual. Hence, stages are skipped without ceremony or previous notice.

A very competent colleague asked me some time since: “Supposing you do not find either changes of rhythm, pitch or tonality, does that preclude the possibility of pulmonary tuberculosis?” By no means. Fall back on the general condition of anæmia, emaciation and loss of muscular power and arrive at a diagnosis by exclusion even while constantly watching for local manifestations. Keep this maxim constantly in mind: The earliest manifestations may be either local, confined to one or more foci in the lung, or general, by which is meant an invasion of the lymphatic system. *Typical text book cases, in which local and general symptoms run along parallel lines, are not the rule, but the exception.* Patients may and do die in large numbers of general tuberculosis involving the lung, or pleura, without a cough and without changes in tonality (quality), pitch or rhythm. This is precisely the reason why every case is to be judged on its own merits as to the character and extent of the local infection as contrasted to a general one. The latter usually invades and involves the pleura; a condition more often overlooked and wrongly diagnosed than any other in the category of diseases. The lymphatic glands in the neck communicate directly into the well-developed lymph system in the pleura, not in the lungs. Not in vain did the late Prof. Jas. A. Leaming speak of the pleura as “the dumping-ground of the lymphatic system.”

THE CIVIL ASPECT OF THE TUBERCULOSIS PROBLEM.

BY ARTHUR J. RICHER, M. D., MONTREAL.

Population being an essential factor in the development of a country, city, town or locality, we are called upon to consider the relationship which exists between the question of population and that of tuberculosis. The two are vitally connected. We know that within certain limits of density, a decrease in the population means the inevitable ruin of that city, town or locality in which it occurs. We know also that protracted epidemics have worked ruin in all ages, wherever they have remained unchecked. Tuberculosis is a protracted epidemic which has thus far resisted all attempts to check its onslaught.

Today we stand facing the vital statistics of the world, and these tell us that two million people die every year as a result of the microscopical vegetable parasite, the tubercle bacillus. So small is this parasite that half a million will find room, if laid side by side, over the area of a five cent piece. The majority of the victims of this germ are felled at the outset of a useful career when they begin to be productive. This fact forces us to consider the economic aspect of the question. Last April, at the annual meeting of the "Canadian Association for the Prevention of Tuberculosis," I attempted to show what financial losses the country sustains by reason of this death-dealing disease, and my computations revealed the fact that in Canada alone they amount to no less than 72 million dollars annually; the municipal share of this loss being not less than four millions each year.

As we have said before, the majority of deaths caused by tuberculosis take place during the period of usefulness, or industrial productivity. This migration into eternity goes on at the rate of 8,000 for Canada, 150,000 for the United States, and 2,000,000 for the entire world yearly.

What can we do to check these terrible ravages? If we look into the subject at all thoroughly we find that the problem presents two very important phases, namely: the "medical" or "scientific" phase, and the "social" phase.

THE MEDICAL PHASE.

Physicians have at all times been devotees to the cause of tuberculosis. They have spared no effort in recording and tabulating clinical ob-

servations bearing upon the subject; those engaged in research work have produced a large number of data resulting from persistent and painstaking experiments which have added very materially to our knowledge of this disease. Those physicians who are particularly engaged in pathological work have, during the last twenty years, supplied us with very valuable information regarding the great prevalence of tuberculosis, even among people during whose life-time it had never been suspected. Among these physicians may be mentioned the name of Otto Nægeli, who recently made a large number of autopsies (500) upon people of all ages, having died of all sorts of diseases. This pathologist, basing his claims upon his findings at these autopsies, concludes that 96% of the population of the civilized world, over the age of 18, is tainted with tuberculosis, in either its latent or active form. This fact then proves to us what I maintained some years ago, namely: that tuberculosis is more a "social" than a "medical" disease.

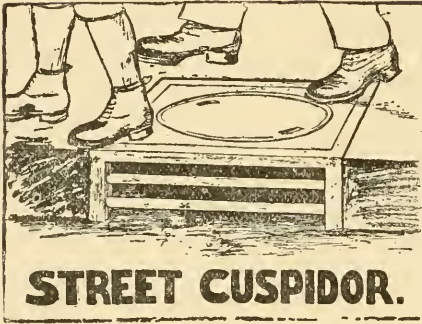
THE SOCIAL PHASE.

The ubiquity of the bacillus of tuberculosis admits of no doubt what ever. The dissemination of the disease has spared no climes. The chronicity of tuberculosis is a well-established fact; but, what should be known more generally by the public, is the fact that the majority of people who suffer from this disease seem to be in possession of abnormally good health. This may sound a little odd and contradictory to you, but all phthisio-therapeutists will bear me out in this.

As we are concerned only with the pulmonary form of tuberculosis, which is by far the most prevalent, and the only form which disseminates the germ through the expectorated matter, we are forced to realize what are the great dangers to which we are exposed by the prevalent habit of promiscuous spitting. When we consider the chronicity of the disease, with the often apparent excellent health of the invalid, and view these facts in the light of the very great dissemination of tuberculosis, we are forced to realize what great need there is for concerted action.

Apart from the matter of cleanliness, anti-spitting by-laws should be in force in all cities, towns and villages. While one can not prevent spitting on the street itself, it should be forbidden upon side-walks, within public buildings, etc., and until the people are trained to make use of the regular street cuspidors, which are now in use in many cities, it is not

amiss to circulate the fact that gullies make very good substitutes, as illustrated below.



If the people can be trained to make use of the gullies as spittoons, it will not be long before they will ask for regular receptacles.

Below will be found an anti-spitting by-law* presented by our Montreal league to the city council.

How should municipalities then attempt to deal with the problem? We know that governmental or municipal legislation alone will avail little. We further know that the application of legislative measures by boards of health are likely to prove hostile to the movement. History will bear me out in this. We have only to refer to the Royal Decree of

*** ANTI-SPITTING BY-LAW.**

TITLE.

By-Law to prohibit spitting upon side-walks, the floors of street-cars and other public conveyances meeting places, halls, churches and other public buildings.

1. No person shall spit upon the floor of any street-car or other public conveyance (while these may be upon or traversing any of the streets, lanes or squares of the City of Montreal), or upon the floor of any theatre, public building, church, opera-house, music-hall or hall used for public meetings; railway or steamboat stations or waiting rooms or other public hall, building, room or place; or upon any platform surrounding, in front of, or in the immediate vicinity of any such place; or upon any sidewalk or covered way.

PENALTY.

2. Whosoever infringes the provisions of this By-Law is liable to a penalty of not less than \$1.00 nor more than \$50.00 with costs of prosecution, or to imprisonment at the discretion of the court.

Naples of 1782, and the Municipal Edict of Nancy (1750), both legislative measures enacted to control the spread of the disease and which, by reason of attempted official application, became dead letters. If we read the report for 1902, of the commissioner of health for the city of New York, we shall be further enlightened.

Legislative measures, applied through official bodies, will only tend to make the sufferer from tuberculosis secrete the nature of his disease. Only measures which offer relief and the probability of a cure will appeal to those afflicted. This shows us that if the official bodies will unite with the philanthropic bodies with the main object in view of dealing delicately and considerately with the sick, the problem at once becomes easy to deal with.

In Montreal, our Anti-Tuberculosis League seems nearest to this coalition of forces. This league, representative of the entire community in which it carries on its work, receives the backing of the provincial and municipal health boards, both being in active coöperation with the league. To illustrate, let me outline the work.

In the first place, the league is in constant communication and in perfect harmony with the several charitable organizations of the city. It is on good terms with the polyclinics of the hospitals and dispensaries, from which tuberculous patients are referred to the league for relief and supervision. It also works harmoniously with the "Victorian Order of Nurses," which supplies the nursing in the homes of those afflicted with the disease; it further unites in its efforts with the "Diet Dispensary," which supplies the several articles of food needed. A relief fund is also made use of to supply immediate wants. The municipal board of health places at the disposal of the league the services of a trained inspector who visits at regular intervals the cases reported to the league. Further, the municipal board of health hands in to the league the returns of deaths from tuberculosis as they are reported to its department of vital statistics. This enables the league to send the inspector and attempt through him to influence the occupants of the house to have it disinfected, or at least the apartments lately occupied by a deceased patient. These efforts have succeeded admirably up to the present time, and we anticipate even greater results. The city health committee has done a large amount of printing for the league, among which are leaflets for public distribution, the titles of which are as follows:

1. "What is tuberculosis?"

2. "How to avoid contracting tuberculosis."
3. "How to avoid communicating tuberculosis to others."
4. "How employers of labor and transportation companies can help to prevent the spread of tuberculosis."
5. "The predisposing causes of tuberculosis, and how to overcome them."
6. "The regimen of life for the tuberculous." (Consumptive)

All of the above are printed both in French and in English, and circulated freely among the sick and the healthy. Thus it will be seen that a great work is being carried on in a large city at very little expense. Yet, it is incomplete, because it should be supplemented by special dispensaries for the tuberculous poor, either isolated or attached to the various hospitals. In order to make the work as perfect as possible it is necessary to have a suburban sanatorium as a probating institution, with a home for incurables; besides which is needed a rural sanatorium. This rural sanatorium should be established in a particularly salubrious locality, affording advantages in its immediate neighborhood for colonizing purposes. Owing to the chronicity of the disease, one realizes the importance of special colonies for the tuberculous.

If municipalities provide accommodation for such other communicable diseases as scarlet fever, diphtheria, measles and small-pox, why not for tuberculosis, which claims more victims than the other four combined?

It is well to remember, that in attempting to establish such institutions the provincial or state governments have large responsibilities, and the federal authorities are most intimately linked to the subject; thus it will be seen that the municipal bodies will not have to act alone, but can depend upon securing the help of the federal as well as of the provincial or state governments, together with that of philanthropic bodies.

Leaving aside the question of public health, to which civic authorities can not be blind, the problem should claim the attention of municipalities, if only for the reason that their treasuries would show a surplus instead of a deficit, by preventing the sickness and death of vital and productive members of the community. Aside from the duty we all owe to humanity, economic reasons alone would more than justify any expenditure incurred by civic governments to stay the ravages of tuberculosis.

THE TRUE THERAPEUTIC ACTION OF ICHTHYOL IN PULMONARY TUBERCULOSIS.

BY JAMES BURNET, M. A., M. B. (EDIN.), M. R. C. P. (EDIN.),
Formerly Resident Physician, Royal Infirmary, Edinburgh.

The value of ichthyol in the treatment of pulmonary tuberculosis is no longer a matter of speculation; it is an accredited fact. Both in America and on the Continent competent observers have proved beyond doubt that ichthyol, when given internally, greatly modifies the disease. In England, however, so far as I am aware, no original work has, up to the present, been recorded. A paper which I read before the Therapeutical Society of London in February last is, I believe, the first real attempt on the part of an English physician to deal publicly with the subject. It is greatly to be regretted that so little work has been done in Britain in connection with the treatment of pulmonary tuberculosis by means of ichthyol. At the same time it is encouraging to find that the little that has been done has shown this substance to be of great value.

It is not my intention in this short paper to narrate my experiences with ichthyol in practice. I have already done so elsewhere. My purpose is rather to give prominence to what I maintain to be its real therapeutic action in tuberculous disease. Different authorities hold different opinions as to how it comes about that ichthyol exerts its beneficial influence when given internally.

From my very extensive study of the literature on the subject, I have come to the conclusion that, as yet, no definite opinion as to its therapeutic action has been formed. For the most part it is given empirically, with the knowledge that it will certainly act beneficially, but the rationale of that action is a matter still obscure and undecided. I have used ichthyol for fully two years in the treatment of pulmonary tuberculosis, and I have given the matter very careful and close attention.

From a study of my own results and those of others I conceive that ichthyol may act in three distinct ways:

1. It may act as an atiseptic.
2. It may act upon nutrition.
3. It may act locally.

I shall now endeavor to place before my readers my own views as to the influence which ichthyol exerts in these three specific directions.

In the first place, let us consider how far ichthyol acts as an antiseptic upon the tubercle bacilli present. If its action is an antiseptic one, then surely fewer bacilli will be found in the sputum after its prolonged administration than were present at the commencement of treatment. All my patients were given ichthyol for at least six months, and in some cases a longer period of administration was observed. On examination of the sputa at the end of six months tubercle bacilli were present in every case; that is to say that ichthyol, although given in large doses for so prolonged a period, did not destroy all the microorganisms. If ichthyol acted antiseptically, then most assuredly a different result would have been obtained. I have always maintained that it is hopeless to attempt to ameliorate pulmonary tuberculosis by administering drugs with the sole object in view of killing the bacilli present in the affected tissues. Although many upholders of ichthyol claim that its beneficial results are mainly due to its antiseptic action, I do not for a moment hold their opinion as correct. It is, I think, very fallacious and calculated to throw discredit upon the remedy by putting it forward under a false claim. If pulmonary tuberculosis could be cured by the administration of antiseptics, surely long ere this we would have had more brilliant results recorded. Just so long as the profession expects good results from such remedies, just so long will it be disappointed. Properties far more reaching in their effects are required if any remedy is to be of service in these intractable conditions.

We must now consider the action of ichthyol upon the general bodily nutrition. During the course of my clinical observations with it in the treatment of tuberculous patients I especially noted two effects which it produced sooner or later; namely, an increased appetite for food and a distinct gain in weight. These observations proved to me most conclusively that ichthyol influences nutrition. Many authorities, Prof. Amory Hare among others, maintain that ichthyol owes its beneficial effect largely to the amount of sulphur which it contains. Now sulphur has but little physiological action on the general system. It is chiefly an alterative agent, although it does modify nutrition to some extent. But it must be kept in mind that ichthyol is more than sulphur; it is a definite chemical compound and as such has a definite action upon the general bodily nutrition. In my own mind there exists no doubt whatever that

ichthyol is a conservator of nutritive force. It seems to have the power of checking waste in the bodily economy, which of course can not be due to the sulphur that it contains, but simply to the sum-total of all the elements composing it. Under its continued administration the nutritive force of tissues is generally raised and hence they are enabled to withstand more readily the action of the tubercle toxin present, rendering its effect less powerful and less destructive.

It is another matter when we come to consider how this action of ichthyol on nutrition is brought about. The solution of this intricate problem does not lie within the reach of the clinician, but of the biological chemist by painstaking laboratory research.

Lastly, I have reserved to the end the consideration of ichthyol with regard to its action upon the local lesion. I have done so because I have come to regard this as the true therapeutic action of ichthyol in pulmonary tuberculosis. Granted that ichthyol is an antiseptic, and granted also that it acts beneficially upon the bodily nutrition, still if it had no action locally upon the diseased tissues, I fear its benefits would be but small. As it is, the action of ichthyol in pulmonary tuberculosis is very marked, and this I maintain is due almost entirely to a direct effect upon the local disease itself. In erysipelas and in acute articular rheumatism local applications of ichthyol rapidly bring about a reduction of the inflammation and a return of the parts to normal. So, too, in gynecological conditions ichthyol pessaries rapidly remove inflammation and congestion of the pelvic organs, because ichthyol is, *par excellence*, a vaso-constrictor. In inflammatory conditions, when applied externally, ichthyol reduces the inflammation, and causes absorption of any exudation that may be present in virtue of its specific action as a vaso-constrictor. So, too, in pulmonary tuberculosis, where inflammation always exists to a greater or less extent, it gradually reduces this, and renders a return of the parts to normal so far as possible. Ichthyol must be regarded as distinctly an anti-inflammatory agent when applied externally, and none the less so when administered in sufficiently large doses internally. The inflammatory process, which is always going on around tuberculous foci, is modified by its action. Hence it comes about, that, time after time, I have observed on examination of the chest of a patient who has been taking large doses of ichthyol for five or six months, the moist sounds gone, the dullness on percussion less extensive than when the patient first came under treatment. This is only what we should expect if we recognize the vaso-constricting

power of ichthyol. Its external action as an anti-inflammatory agent has long been recognized, and hence there should be little difficulty in concluding that when given internally ichthyol has a similar action. I have not had an opportunity as yet of giving intratracheal injections of ichthyol, but I feel certain they would have a more rapid effect upon the diseased pulmonary tissue than has ordinary oral administration; moreover, less would be required to achieve the same results. Lately I have tried the external inunction of ichthyol in vasogen over the affected part, at the same time giving ichthyol internally by means of capsules. In the few cases I have experimented on the results have been uniformly good, and I think somewhat more quickly observed than when no local application was made.

From what has been said it will be gathered that I am no believer in the theory that ichthyol owes its action to its antiseptic property, nor in the view that its beneficial effects are entirely due to its action upon nutrition. We must go further afield, and regard ichthyol in its true light, as a vaso-constrictor, and as an anti-inflammatory agent. This is its real action, and the only one which is of much value in the application of the remedy to cases of pulmonary tuberculosis. Thus regarded, ichthyol becomes a remedy of the greatest importance, and well worthy the support of the profession everywhere.

ORIGINAL TRANSLATIONS.

THE ADVANTAGES OF THE COMBINED METHOD OF TREATMENT IN CHRONIC TUBERCULOSIS.*

BY DR. J. MITULESCU, BUKAREST.

In order to obtain a radical cure in chronic tuberculosis of the lungs we must employ the remedies that have been given us by science and by clinical experience, whose function it is to increase the vitality of the cells in order to enable them to generate protective substances which impede the development of the tubercle bacillus and neutralize its toxins. We can only hope to obtain a sclerosis limiting the growth of the tubercles when these principal conditions have been fulfilled; in other words, when the vitality of the bacillus is weakened directly or indirectly, and when the nutrition of the body is improved. The absorption of the tuberculous proteins then becomes impossible, and one by one the tuberculous foci are surrounded by sclerotic tissue or undergo calcification.

Under these conditions the tubercles can no longer have any injurious effects and the organism is no longer threatened; the cells are in a condition to resist the disease and nothing but a new infection can produce a reëpppearance of the general symptoms. Only those cases can be considered as truly cured, in which the injection of tuberculin no longer induces an organic reaction. If the bacteria are only enclosed in the sclerotic tissue and have retained their poisonous properties, continuing to generate toxins, which, however, are constantly neutralized by the wandering cells so that the organism is not threatened, then the disease is in a latent condition, and the cure is only apparent. Sooner or later the cells lose their faculty of maintaining the equilibrium under the influences of various mechanical and chemical factors which lower their resistance. This creates better conditions for the development of the bacteria, and their non-neutralized secretions flood the organism, which manifests symptoms of disease. It is possible to obtain a permanent cure in the early stage as well as in the stationary period which follows, provided the treatment which fulfills the above-mentioned requirements be continued for a sufficient

*Translated for *The Journal of Tuberculosis* from the *Deutsche med. Wochenschrift*, May 21-28 1903.

length of time. If the lesions as well as the general symptoms are too far advanced, only a more or less prolonged improvement can be hoped for.

The treatment which is now regarded as the most approved and which promises a general improvement, as well as a cure, is the hygienic and dietetic. With this treatment we seek to improve the nutrition of the cells and, therefore, to increase the resistance of the body; in other words, to produce a condition which approaches the normal. This can be done only under two conditions:

1. By giving the organism a sufficient amount of food and securing the proper absorption thereof, thus giving the cells an opportunity to cover the losses sustained.

2. By increasing the functional activity of the cells; in other words, by spurring them to an ever increasing capacity for work, in order to cause them to absorb a constantly increasing amount of compensatory substances. We know that the cells absorb the necessary material from the fluid media surrounding them, according to their needs, in order to replace their loss of substance, and we may understand how important it is to stimulate the cells progressively and constantly; in other words, to increase their capacity for nutrition and therefore their vitality.

This stimulation may be effected by means of various remedies, such as lecithin, iron, arsenic, etc.; by hydrotherapy, by the inhalation of oxygen, and ozone, as well as by progressive movements. It is a well-known principle of hydrotherapy that the cooling of the body promotes oxidation so long as the temperature of the body remains the same, while heating it diminishes oxidation under these conditions. When the temperature of the body is lowered, however, then the opposite holds good. The temperature, therefore, must be so regulated that it is neither lowered nor raised. The cold-water treatment, which produces rapid effects by cellular stimulation, should be employed only in those cases in which the cellular resistance is great and in which the cells have retained their faculty of reacting. This treatment strengthens the organism and renders it resistant to changes of temperature. As regards the question of exercise, some authors¹ think that tuberculous patients should not be allowed to indulge in bodily movements so as not to add a new intoxication to that produced by the tuberculous toxins. This new intoxication must be produced through the influence of various products of decomposition which arise during the movements. On the other hand,

H. WEBER² maintains that even patients who show a slight fever should exercise. The investigations of LOEW³ have shown that muscular movements at first produce a decomposition of proteins which is not compensated, but that later on, these substances are retained in the organism, thus producing an over-assimilation which is employed to cover the losses sustained. Exercise must, therefore, be progressive, and must, like the other features of the treatment, be specially adapted to each case.

As regards the feeding, we must remember that the food should contain always a sufficient amount of proteids and nucleo-proteids which represent integral constituents of the cell body and which enable the cells to fulfil their vital functions⁴. The amount of these substances is determined by the needs of the organism itself, and, in order that they may not be exposed to oxidation, they should be protected by isodynamic substances, such as fats, carbohydrates, etc. The introduction of an excessive amount of proteids, especially in a but slightly assimilable form, would only produce an increase in the products of decomposition in the intestine, which, on being absorbed, would cause auto-intoxication of digestive origin that is always to be carefully avoided.

We should seek in tuberculosis to stimulate the organism to a greater assimilation of albumin in order to fulfil the demand of the body to increase the resistance of the cells, without, as is often the case, producing a marked deposit of fat which can not be utilized at once and accumulates in the internal secretions as well as in the cells themselves, and therein works injury by lowering the respiratory and nutritive activity. Besides, it is very easily possible that organic cells whose vitality is lowered do not resist properly against fatty infiltration, so that the fatty tissue oversteps its boundaries, penetrates in the differentiated organs, and thus injures the cells in the performance of their functions. It is absolutely necessary, therefore, to promote, so far as possible, the accumulation of proteids, and to increase gradually the metabolism of these substances in the cells themselves by various stimulants. Only in this way can we raise the vitality of the cells, and, therefore, their resistance; in other words, fulfil the principal requirement of this treatment. We must also give due consideration to the important fact which has been brought out in my first communication⁵; namely, that in many cases of tuberculosis in the first stages, the cellular waste is markedly increased without being replaced. It is, therefore, necessary to determine, with the greatest caution, so far as possible, in each case by the calculation of the coefficient of cellular

nutrition, whether the case is one in which these stimulants of cellular nutrition may be employed.

If this indirect mode of treatment of the infection and intoxication is kept up for a sufficient length of time, especially in the early stages of the disease, we can hope to obtain a permanent improvement of the general condition. But the bacillus still retains its poisonous properties which at some future time may become dangerous to the organism through a diminution of cell resistance.

It is easily explained, therefore, why the beautiful results obtained with this method of treatment in institutions are of short duration; for these results can not continue under the conditions of life in which the patient lives after leaving the sanatorium. Thus, for example, ENGELMANN⁶ found that of 6273 patients who had remained under treatment for at least three months 74 per cent. were dismissed as fully capable of going on with their work. After four years, however, 79.9 per cent. of these patients had either died or had become incapable of working, while 44 per cent. of the patients who had been in the early stage were still capable of pursuing their work. According to the statistics of BIELEFELD⁷, which were presented to the London Congress, 70.74 per cent. of patients were dismissed as cured or apparently cured after the termination of the treatment. Two years later, only 44 per cent. of these were found capable of pursuing their work. Dr. WEICKER⁸, of the Görbersdorf Sanatorium, also found apparent cures in 72 per cent., but after two years only about 46 per cent. of these patients were capable of pursuing their vocations. HAMMER⁹, of the State Insurance of Baden, compared the results of treatment in sanatoria (on the average of three months duration) with those obtained in various dispensaries, and found that treatment in the former yielded about 74 per cent. of improved cases after one and one-half years, of which 35 per cent. were complete cures, and 38 per cent. were but average successes, while in 69 per cent. of the patients treated in dispensaries there were 52.7 per cent. of complete successes and 16 per cent. of average successes. Basing his opinion upon these figures, this author concludes that the treatment in sanatoria is of no distinct value. Weicker is of the opinion that under strict supervision a permanent cure can be obtained after two years' treatment in not more than 40 per cent., while in the remainder of the patients it is only a question of postponing the fatal issue. He says: "We want to produce a healthy people by this treatment; not a crowd of convalescents."

JESSEN¹⁰ thinks that sanatoria have thus far not fulfilled the requirements that have been set for them, and that only a small proportion of the patients have been benefited by a stay in these institutions. We must, therefore, seek other means in order to obtain more favorable results.

In addition to the treatment, the purpose of which consists in raising the nutritive power of the cells, we must employ means which favor the formation of protective substances through the action of which the injurious influences of the bacillus, of its toxins and proteins, are neutralized and through the influence of which the organism may be led to a cure.

For this purpose a number of chemical substances have been recommended which are supposed to exercise a definite antiseptic action. Among these there are a few which are extensively employed even today; as for example, creosote and its derivatives, as well as sodium cinnamate. In addition to their general stimulating effect, these substances also possess the property of increasing the general and local leucocytosis, but they do not give rise to the formation of protective substances in large amounts, which could influence the bacterial products. Such protective substances are formed only under the influence of certain specific agents. Therefore, we shall speak only of active and passive immunization in tuberculosis. In active immunization the cells are spurred to the formation of antitoxins which diminish or destroy the vitality of the bacteria and neutralize the toxins. This result is arrived at by the injection of bacterial products and secretions. In passive immunization the antitoxins are first made and then introduced directly. The ideal treatment would consist in the introduction into the tuberculous organism of the amboceptor, which could adapt itself to the complement or the natural alexins, in order to exercise its destructive influence upon the bacillus and its secretions and thus to assist the cells. The latter would then be spared the overwork and would confine themselves, thanks to the action of various fermentative substances, to the assimilation of nutrition and to the renewal of destroyed tissues. The cells of a tuberculous organism have a double task before them; on the one hand they must take in the material necessary for reconstruction, and on the other they must protect themselves against the action of poisonous substances. As the tubercle bacillus may become fatal not only through its secretions, but even after its death through the absorption of substances which constitute its body, the antituberculous

serum must, in order to exercise a definite influence, contain, on the one hand, the antitoxin, and on the other, the corresponding amboceptor, and finally, substances which are capable of neutralizing the proteins which constitute the body of the bacillus.

According to this theory, the antituberculous serum of Maragliano is an antitoxin which is supposed to neutralize the secretions of the tubercle bacillus and which, in addition, is said to be a stimulant to the cells. Until a more successful modification shall have been obtained which complies with the above-mentioned requirements, the active form of immunization, by the injection of the toxins and proteins of the tubercle bacillus, must be used to a great extent. This process, if employed with care in the appropriate cases, induces, as KOCH¹¹ and recently BEHRING¹² have shown in cattle, a well-marked state of immunity by stimulating the cells, to form specific antagonists against the bacteria and their products and thus enables them to protect themselves.

This means the extension of the normal process of tuberculosis itself; i. e., under the influence of the tuberculous toxins and proteins in the tuberculous focus, the cells crowd about these lesions in large numbers, and so form actual protective walls. Those cells which possess a sufficient degree of vitality form protective substances which tend to neutralize the toxic secretions of the bacteria. In this manner a state of rest is induced, and, so long as the cells remain resistant, the apparent cure continues; for, in the normal condition, protective substances are generated only in very small quantities, and the bacteria retain their original toxicity in order to continue to develop when the cellular resistance diminishes.

The injection of specific substances, or of their products, aims at driving the cells surrounding the focus to the formation of larger amounts of these substances, and also induces the other organic cells, especially the leucocytes, to form such protective substances, which later on are carried to the point of attack. According to KOCH¹³ the progress of immunization may be determined by the reaction of agglutination, with which immunization runs parallel, up to a certain point, and afterwards slowly diminishes. In this manner the bacilli are rendered less poisonous and their toxins and proteins are neutralized, the number of cells which surround the focus grows larger, and so the chief requirements for immunization are fulfilled and under appropriate conditions a permanent cure is effected. As tuberculin is a strong excitant of cells, it can be employed as I have shown in a previous article¹⁴ only in those cases in which the cells

are still capable of reacting to its stimulus. The use of tuberculin is, therefore, justified only in the early stage of tuberculosis, in which the cells are only temporarily disabled through overwork and through the impossibility of forming specific substances. If the cells be enabled to form these substances, and if the accession of reinforcements be assisted, they retain the upper hand, a fact which is apparent, through a slight increase of nitrogen. If we introduce a large amount of tuberculin in these cases, or if we employ this remedy in cases in which the vitality is low and the destruction of the cells is difficult to stem, the injection will simply increase the morbid condition of the cells, a fact which is shown by an increased disassimilation. The cautious use of tuberculin is also indicated in cases in which the condition is stationary, as the remedy can raise the cell resistance under these conditions.

These two forms of treatment are mutually complementary and the successes obtained by the combined treatment are much greater than those resulting from the use of either method separately. The dietetic treatment supplies the need of furnishing the cells with the necessary restoratives and of increasing their nutritive capacity. Specific substances are formed only in such amounts as the organism needs at a given moment; the infection and intoxication remain hidden in order to break out again when the organism is in a weakened condition. By the simultaneous use of the dietetic and the specific treatment, a general as well as a special stimulus is given to the cells to form substances which tend to render the conditions of life unfavorable for the bacillus by diminishing its toxicity and thus securing a permanent cure. After the vitality of the bacillus has been diminished, and after the organism is no longer under the influence of its poisonous products, there is an increase of proteid absorption which to a certain extent runs parallel to the agglutination, and therefore informs us as to the state of immunity present. In order to use this treatment with success, we must first bring the body of the patient into nitrogenous equilibrium by diet and by the employment of specific injections.

A fundamental condition for the success of this treatment is, that the organic reaction, which is externally manifested by fever, should not be too marked, for if this be the case, as I have shown before, there is increased decomposition of the organic albumin on the one hand, and a marked local congestion of the lungs which may become very unfavorable. In order that this combined treatment may have the desired success,

it must be continued for a considerable length of time. In order that the public sanatoria may secure the proper results and in order that the poor who are exposed to so many trials in the struggles of daily life may obtain prolonged improvement or apparent cure, this combined treatment must be used until the day comes when the true specific remedies shall have been discovered. This method is being adopted more and more extensively, for it is becoming apparent that it gives favorable results.

Thus, RENBOLDT¹⁵ treated forty cases by means of diet and tuberculin. Twenty-nine of these had remained in a state of apparent cure after six years of observation. TURBAN¹⁶ used the combined method with the following result: Of 86 patients who were treated with tuberculin, and who had bacilli in the sputum, 45 or 52 per cent. showed prolonged improvement. Of 241 cases with bacilli in the sputum which he treated with creosote 95, i. e. 34 per cent., showed prolonged improvement. MÖLLER and KAYSERLING¹⁷ showed that of 18 patients who had been treated in the Belzig Sanatorium with tuberculin, nine in the first stage and seven in the second stage (according to Turban) showed very good and prolonged improvement. KRAUSE¹⁸ employed the same treatment in 27 cases and obtained 12 apparent cures and 15 prolonged improvement. MARAGLIANO¹⁹ obtained the following results in 171 cases treated in a dispensary with his serum: 44 cured; 64 improved; 51 stationary. PETRUSCHKY²⁰ estimates the percentage of patients permanently cured by means of the specific treatment as between 60 per cent. and 80 per cent. and compares these results with those obtained with the simple dietetic treatment as follows (Englemann's statistics):

| | | |
|--|---|---|
| Simple treatment: In 1st stage, 44 per cent. prolonged improvement | | |
| Simple treatment: In 2nd stage, 16.7 per cent. | " | " |
| Simple treatment: In 3rd stage, 0 per cent. | " | " |
| Combined treatment: In 1st stage, 90-100 per cent. prolonged improvement | | |
| Combined treatment: In 2nd stage, 40-50 per cent. | " | " |

The following are short notes of a few cases, accompanied by a record of the balance of metabolism, which illustrate what I have said above and which show that the combined dietetic and specific treatment of tuberculosis is alone capable of securing the retention of nitrogen in the organism:

Case 1.—A. S., Laundress, aged 38 years, admitted May 23, 1902. The history does not point to tuberculosis. Since 1894 the patient has been suffering from pharyngitis. In September of last year she was seized with a double pneumonia and pleurisy and

diphtheria. Since then she complains of a stabbing pain in the side, and of attacks of cough and expectoration, which are becoming steadily worse.

Examination of the lungs: On the left side, in front and behind, the apex shows slight dullness, with fine, moist râles. Below the scapula friction sounds are noted. On the right side the apex shows shortening of the duration of the sound, higher pitched inspiration and prolonged expiration. No tubercle bacilli were seen in the sputum. (See *Table I.*)

Case 2.—M. D., Ironer, aged 30 years, admitted April 30, 1902. A brother of the patient died six years ago of tuberculosis; a sister has been suffering from an affection of the lungs for about seventeen weeks. The patient has lived with her brother and has nursed him. Since December she has been suffering from cough, with quite marked expectoration and night-sweats, as well as from attacks of pain in the chest. Four months ago she had two pulmonary haemorrhages. She has a flabby musculature and very little adipose tissue. The mucous membranes are somewhat pale. At the right apex the respiration is bronchial, the percussion-sound is less resonant, and there are small, moist râles. On the left side, at the apex in front, there is rough inspiration, sibilant and sonorous breathing; behind, small, moist râles, and below, dry friction-sounds. Tubercle bacilli were found in the sputum. (See *Table II.*)

Case 3.—A. B., Seamstress, 18 years old, admitted on April 22, 1902. Nothing in her history pointed to tuberculosis, but the patient passed her life under very unfavorable circumstances. In August of this year there appeared at first a severe dry cough, to which was added, six weeks later, some expectoration, as well as night-sweats. These symptoms were somewhat relieved by medical treatment. At the beginning of March the above signs reappeared, this time with pains in the left side. There followed weakness, loss of appetite and sleep. Over the left apex there was diminution of resonance, bronchial breathing and fine, moist râles. On the right side, isolated râles. Tubercle bacilli were found in the sputum. (See *Table III.*)

Case 4.—H. H., Seamstress, aged 34 years, admitted April 19, 1902. Her mother had diabetes, her father has coughed since last winter and complains of difficulty in breathing. She lives in favorable hygienic conditions. A year ago she had an attack of pleurisy, and since September last she complains of stabbing pains in the left side of the chest and back, of great weakness; of cough and expectoration. Eight days ago the expectoration became bloody and remained so for three days.

Examination of the lungs: On the left side of the apex, slight dullness, sharpened inspiration, sonorous and fine, moist râles. At the upper part of the lungs behind, bronchial breathing; below, dry crackling. Tubercle bacilli were found in sputum. (See *Table IV.*)

It will be seen from these tables that in the first case, which was treated only by hygiene, with an increase of nitrogenous food, the increase of nitrogen and phosphorus was but very slow and gradual, and the loss through the intestine was relatively great, although the intestinal activity was normal. In the other three cases, exactly the same conditions obtained until the tuberculin treatment was added. From this moment on,

the loss of proteids still increased, but not so markedly as in the first case, while the accumulation of nitrogen and phosphorus were quite considerable.

A large increase in the proteids retained is possible only after several injections of tuberculin. This is due to the fact that the cells are in a state of marked excitability, and therefore, their vitality being increased, they exhibit a much greater power of assimilation.

TABLE 1.

| Income | | Expenditure | | | | | | Balance | | Temperature |
|----------|-------|----------------|------|--------|---------------------|--------|-------|---------|--------|-------------|
| N | Ph. | Faeces | | Urine | | | | N | Ph. | °C |
| | | N | Ph. | Date | Am't | N | Ph. | | | |
| 13.25 | 3.76 | 1.13 (D.t.) | 1.24 | May 28 | $\frac{1100}{1010}$ | 11.63 | 2.35 | +0.42 | +0.17 | 36.2—36.8 |
| | | | | 29 | $\frac{1200}{1015}$ | 11.98 | 2.43 | +0.14 | +0.09 | 36.3—36.9 |
| | | | | 30 | $\frac{1250}{1015}$ | 11.51 | 2.15 | +0.69 | +0.37 | 36.3—36.9 |
| | | | | 31 | $\frac{1350}{1015}$ | 11.06 | 1.98 | +1.06 | +0.54 | 36.5—37 |
| 17.25 | 3.782 | 2.48 (D.t.) | 1.34 | June 1 | $\frac{1200}{1018}$ | 13.86 | 2.246 | +0.91 | +0.196 | 36.4—37 |
| Of which | | | | 2 | $\frac{1300}{1016}$ | 13.65 | 2.153 | +1.12 | +0.289 | 36.4—36.9 |
| 4 gr. | | | | 3 | $\frac{1200}{1017}$ | 12.95 | 1.95 | +1.72 | +0.492 | 36.5—37 |
| N and | | | | 4 | $\frac{1150}{1017}$ | 12.86 | 1.782 | +1.92 | +0.66 | 36.6—37 |
| 0.022 | | | | 5 | $\frac{1250}{1018}$ | 13.15 | 1.951 | +1.62 | +0.191 | 36.5—37 |
| Ph. in | | | | 6 | $\frac{1200}{1018}$ | 13.68 | 2.14 | +1.09 | +0.302 | 36.6—37 |
| the | | | | 7 | $\frac{1150}{1020}$ | 13.91 | 2.48 | +1.72 | +0.044 | 36.5—37.1 |
| form | | | | 8 | $\frac{1200}{1020}$ | 14.45 | 2.253 | +1.18 | +0.271 | 36.8—37.4 |
| of Ro- | | | | 9 | $\frac{1150}{1019}$ | 13.88 | 2.153 | +1.75 | +0.371 | 36.3—37 |
| borat. | | | | 10 | $\frac{1250}{1020}$ | 13.14 | 2.38 | +2.49 | +0.164 | 36.5—37 |
| 21.25 | 3.804 | 5.62 (D.t.) | 1.28 | 11 | $\frac{1150}{1019}$ | 12.85 | 2.153 | +2.78 | +0.371 | 36.5—37.2 |
| 8 gr. | | | | 12 | $\frac{1250}{1020}$ | 12.71 | 2.486 | +2.02 | +0.068 | 36.8—37.1 |
| N and | | | | 13 | $\frac{1200}{1020}$ | 12.986 | 2.354 | +2.634 | +0.170 | 36.9—37.1 |
| 0.0435 | | | | | | | | | | |
| Ph. in | | | | | | | | | | |
| 50 gr. | | | | | | | | | | |
| Robo- | | | | | | | | | | |
| rat. | | | | | | | | | | |

TABLE II.

| Income | | Expenditure | | | | | | Balance | | Temp. | Tuberc. Injec. |
|------------|--------|-------------|------|--------|-----------------------|-------|-------|---------|--------|-----------|-------------------|
| N | Ph. | Faeces | | Urine | | | | N | Ph. | °C | |
| 12.45 | 3.86 | 1.26 | 1.15 | June 2 | $\frac{11.00}{16.18}$ | 11.48 | 2.98 | -0.29 | -0.27 | 36.2—36.8 | |
| | | (D.t.) | | | | | | | | | |
| | | | | 3 | $\frac{11.20}{16.18}$ | 11.25 | 2.79 | -0.06 | -0.08 | 36.3—37.2 | |
| | | | | 4 | $\frac{11.00}{16.18}$ | 11.36 | 2.56 | -0.17 | -0.15 | 36.2—37.3 | |
| | | | | 5 | $\frac{11.00}{16.18}$ | 10.98 | 2.65 | -0.21 | -0.06 | 36.3—37.1 | |
| | | | | 6 | $\frac{11.00}{16.18}$ | 10.86 | 2.56 | -0.33 | -0.15 | 36.5—37.2 | |
| | | | | 7 | $\frac{11.20}{16.18}$ | 10.86 | 2.48 | -0.33 | -0.22 | 36.8—37.2 | |
| 12.45 | 3.86 | 1.86 | 1.45 | 23 | $\frac{11.00}{16.20}$ | 14.98 | 2.762 | -0.39 | -0.33 | 36.8—38 | |
| +4 | — | (D.t.) | | | | | | | | | |
| | -0.022 | | | 24 | $\frac{11.00}{16.18}$ | 13.66 | 2.543 | -0.93 | -0.111 | 36.8—37.5 | |
| 25 g. Rob. | | | | 25 | $\frac{11.00}{16.18}$ | 13.25 | 2.563 | -1.34 | -0.131 | 36.8—37.3 | |
| | | | | 26 | $\frac{11.00}{16.18}$ | 12.96 | 2.411 | -1.63 | -0.21 | 36.2—37.2 | |
| | | | | 27 | $\frac{11.00}{16.18}$ | 13.35 | 2.25 | -1.24 | -0.102 | 36.8—37.4 | |
| | | | | 28 | $\frac{11.00}{16.18}$ | 13.16 | 2.14 | -1.43 | -0.29 | 36.9—37.3 | |

TO 0.01

TABLE III.

| Income | | Expenditure | | | | | | Balance | | Temp. | Tuberc. Injec. mg. |
|--------------|-------|-------------|------|--------|---------------------|-------|-------|---------|--------|-----------|--------------------------|
| N | Ph. | Faeces | | Urine | | | | N | Ph. | °C | |
| | | N | Ph. | Date | Amt | No. | Ph. | | | | |
| 13.25 | 3.76 | 1.34 | 1.22 | May 7 | $\frac{1000}{1015}$ | 12.25 | 2.86 | -0.34 | -0.32 | 36.9-37 | TO=0.1 mg. |
| | | (D.t.) | | 8 | $\frac{1200}{1015}$ | 12.05 | 2.68 | -0.14 | -0.14 | 36.9-37.1 | |
| | | | | 9 | $\frac{1150}{1015}$ | 11.83 | 2.25 | +0.08 | +0.29 | 36.7-37 | |
| | | | | 10 | $\frac{1250}{1016}$ | 11.62 | 2.48 | +0.29 | +0.06 | 36.8-37.2 | |
| | | | | 11 | $\frac{1100}{1015}$ | 11.48 | 2.25 | +0.43 | +0.29 | 36.8-37.1 | |
| | | | | 12 | $\frac{1300}{1016}$ | 11.75 | 2.36 | +0.16 | +0.18 | 36.7-37.2 | |
| 17.25 | 3.782 | 2.11 | 1.24 | 29 | $\frac{1100}{1021}$ | 14.48 | 2.48 | +0.66 | +0.062 | 36.8-37 | |
| (25 g. Rob.) | | | | 30 | $\frac{1250}{1020}$ | 14.85 | 2.371 | +0.29 | +0.171 | 36.9-37.1 | |
| | | | | 31 | $\frac{1000}{1020}$ | 14.98 | 2.48 | +0.16 | +0.062 | 36.7-37.4 | |
| | | | | June 1 | $\frac{1200}{1020}$ | 13.56 | 2.371 | +1.58 | +0.171 | 36.8-37.2 | |
| | | | | 2 | $\frac{1250}{1019}$ | 13.28 | 2.26 | +1.86 | +0.278 | 36.5-37.4 | |
| | | | | 3 | $\frac{1300}{1018}$ | 13.66 | 2.52 | +1.48 | +0.022 | 36-37.1 | |
| | | | | 4 | $\frac{1200}{1017}$ | 13.18 | 2.481 | +1.96 | +0.61 | 36.2-37.2 | |
| 21.25 | 3.804 | 3.58 | 1.14 | 5 | $\frac{1350}{1018}$ | 15.25 | 2.35 | +2.42 | +0.324 | 36.8-36.6 | |
| (25 g. Rob.) | | | | 6 | $\frac{1200}{1020}$ | 14.25 | 2.561 | +3.42 | +0.113 | 36.7-37 | |
| | | | | 7 | $\frac{1100}{1021}$ | 13.89 | 2.62 | +3.78 | +0.054 | 36-37.2 | |
| | | | | 8 | $\frac{1250}{1022}$ | 14.25 | 2.543 | +3.42 | +0.131 | 36.2-37.1 | |
| | | | | 9 | $\frac{1300}{1021}$ | 14.68 | 2.543 | +3.08 | +0.131 | 36.2-37.2 | |

TABLE IV.

| Income | | Expenditure | | | | | | Balance | | Temp. | Tuberc. Injec. |
|----------------|---------------|-------------|------|--------|---------|---------------------|-------|---------|-------|--------|-------------------|
| | | Faeces | | Urine | | | | | | | |
| N | Ph. | N | Ph. | Date | Amt | No. | Ph. | N | Ph. | °C | mg. |
| 12.45 | 3.86 | 1.25 | 1.15 | (D.t.) | April | | | | | | |
| | | | | | 19 | $\frac{1200}{1018}$ | 11.53 | 2.95 | -0.33 | -0.24 | 37-37.2 |
| 10.45 25 g. | 3.882 Rob. | | | | 20 | $\frac{1300}{1017}$ | 11.05 | 2.42 | +0.15 | +0.29 | 36.8-37.2 |
| | | | | | 21 | $\frac{1100}{1021}$ | 14.75 | 2.625 | +0.45 | +0.107 | 36.8-37.1 |
| | | | | | 22 | $\frac{1200}{1022}$ | 14.37 | 2.561 | +0.83 | +0.171 | 36-37.2 |
| | | | | | 23 | $\frac{1300}{1018}$ | 14.56 | 2.865 | +0.64 | -0.133 | 36.8-37.5 |
| | | | | | 24 | $\frac{1200}{1020}$ | 14.98 | 2.962 | +0.22 | -0.231 | 36.8-37.3 |
| | | | | | 25 | $\frac{1400}{1017}$ | 13.84 | 2.563 | +1.36 | +0.169 | 36.7-37.1 |
| | | | | | 26 | $\frac{1200}{1018}$ | 13.25 | 2.24 | +1.95 | +0.492 | 36.5-36.8 |
| | | | | | 27 | $\frac{1300}{1018}$ | 13.52 | 2.158 | +1.68 | +0.574 | 36.5-37 |
| 16.45 (R) | 3.882 | 1.56 | 1.24 | | 28 | $\frac{1250}{1020}$ | 14.38 | 2.58 | +0.82 | +0.162 | 36.8-37.5 |
| | | | | | 29 | $\frac{1135}{1019}$ | 13.85 | 2.185 | +1.35 | +0.547 | 37-37.3 |
| | | | | | 30 | $\frac{1300}{1018}$ | 13.22 | 1.98 | +1.98 | +0.751 | 37-37.3 |
| | | | | | June 18 | $\frac{1200}{1015}$ | 12.56 | 2.215 | +2.33 | +0.427 | 36.8-37 |
| 12.65 16.45 | 3.28 3.882 | | | | 19 | $\frac{1300}{1014}$ | 12.25 | 2.353 | +2.54 | +0.289 | 36-36.8 |
| | | | | | 20 | $\frac{1200}{1018}$ | 12.15 | 2.71 | -1.06 | -0.67 | 36.8-38.5 |
| | | | | | 21 | $\frac{1200}{1019}$ | 12.76 | 2.456 | +2.13 | +0.186 | 38.2-37 |
| | | | | | 22 | $\frac{1150}{1018}$ | 12.41 | 2.21 | +2.48 | +0.432 | 36.2-36.8 |
| 20.45 50 g. | 3.904 Rob. | | | | 23 | $\frac{1250}{1018}$ | 12.86 | 2.35 | +6.03 | +0.314 | 36.3-36.8 |
| | | | | | 24 | $\frac{1100}{1017}$ | 12.25 | 2.142 | +6.64 | +0.522 | 36.4-36.5 |
| | | | | | 25 | $\frac{1200}{1016}$ | 12.38 | 1.961 | +6.51 | +0.703 | 36.3-36.8 |
| | | | | | 26 | $\frac{1150}{1015}$ | 12.08 | 2.142 | +6.81 | +1.022 | 36.3-36.8 |

TO=0.01

TO=0.03

TO=0.06 iv

After gradually increasing injections

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THE ACTION OF HUMAN GASTRIC JUICE UPON THE TUBERCLE BACILLUS: A CONTRIBUTION TO THE STUDY OF PRIMARY GASTRO-INTESTINAL TUBERCULOSIS.*

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The possibility of a tuberculous infection through the digestive tract, and the ability of the gastric juice to destroy the virulence of the tubercle bacillus, are elements in one of the most disputed questions in the field of tuberculosis.

The principal early investigators of this question, such as Chauveau, Klebs, Bollinger, Orth, Peuch, Gerlach, Spillman, Toussaint, John, Günther, Villemin, Falk, Wesener, Strauss and Wurtz, Heller, etc., claim to have demonstrated the possibility of transmission of tuberculosis to the digestive tract. On the other hand, the opposite opinion is held by Colin, of Alford, Tappeiner, Verga and Biffi, Ribbert, Dubuisson, Mosler, Sormani, Chatin, Nocard, Semmer, Parrot, Viséur, Saint-Cyr, Perroncito, etc.

This important question has remained unsolved, although it has been discussed from the very beginning of the bacteriological studies on tuberculosis, and it has been taken up once more, recently, after the announcement of the conclusions of Koch upon the diversity of human tuberculosis from that of the other mammals, partly on the ground that tuberculous infection through the digestive tract was very rare.

It is strange, however, that in the various experiments instituted towards the solution of this question the observers have not sought to place themselves in the most natural conditions. Many authors have relied entirely upon clinical and pathological observations of tuberculous lesions of the digestive organs. Others, who tried the experimental method, contented themselves with causing various animals to ingest tuberculous material or with inoculating them with tubercle bacilli that had been kept for a certain length of time in the gastric juice of a dog or in artificial gastric juice. Of necessity, the results obtained by these observers were uncertain, contradictory, and of no value in clinical work. As early as

*Translated for the *Journal of Tuberculosis* from *Riforma Medica*, June 24, 1903. Vol. XIX., No. 25, p. 679.

1884, Sormani noted that gastric juice of some animals does not possess the power of destroying the virus of tuberculosis, that the latter is very resistant to the action of artificial digestive juices, but that it can be destroyed by the gastric juice of other animals.

These observations should have at once caused subsequent observers to confine their experiments to human gastric juice, in order to place the question upon the terms in which it is presented clinically. In spite of this, however, investigators continued to experiment with the juice of animals and with artificial gastric juice, and even Carrière, who has written recently on the subject, used artificial gastric juice almost exclusively. It is very easy to obtain natural gastric juice in the clinic, and I have thought best to employ it in my experiments.

I determined the total acidity of the gastric juice which I used, and also the amount of free hydrochloric acid. I then prepared two series of four sterilized test tubes, each containing five c. c. of gastric juice. In each of these series there was one test tube with natural gastric juice, another with boiled gastric juice, a third with its contents of free hydrochloric acid neutralized, and a fourth in which the amount of hydrochloric acid was increased to 2 parts to 1000; in other words, to the maximum limit which it can reach under physiological conditions. To each one of the two series of test tubes a fifth tube was added, containing five c. c. of sterilized water. To each test tube I added one or two fatal doses of culture of human tubercle bacilli, according to the number of guinea pigs to be inoculated. The tubes were then placed in an incubator at 37° C., and were left there, the first series for one hour, and the second series for two hours. The tubes were then removed and their contents was accurately neutralized. With this I then inoculated guinea pigs into the peritoneum.

In this manner, it seems to me, I have imitated natural conditions as closely as possible, for I have studied the action of human natural gastric juice, at the ordinary temperature of the body, during a time which corresponds approximately to that during which substances swallowed remain in the stomach.

The results were almost uniform. In all the experiments no guinea pig escaped infection with tuberculosis. It must be added, however, that among the guinea pigs inoculated with gastric juice which contained 2 to 1000 of free hydrochloric acid, and which was allowed to remain in the incubator in contact with the bacilli of tuberculosis for two hours, a

number died later than the others, or presented less pronounced lesions at the autopsy. But it is certain that all the animals were affected with tuberculosis, and that the experiments showed that the human gastric juice, even when it contains two parts in a thousand of free hydrochloric acid, can not protect the gastro-intestinal tract from a tuberculous infection after an exposure of one or two hours. This is the important practical conclusion of this work.

There was no reason for protracting the action of the gastric juice beyond two hours, as has been done by other observers; because by doing so we would destroy the natural conditions of digestion. It can not be thought that normally a substance remains in the stomach for ten or twelve hours, or longer. The question as to why a primary intestinal tuberculosis is difficult to produce, in spite of the fact that the gastric juice has not the power to protect the digestive tract from a tuberculous infection, and in spite of the fact that material infected with tubercle bacilli must be eaten quite frequently, does not come into the scope of the present research. We can only guess that it may be because of the slight susceptibility on the part of the intestine, or of some special action of the intestinal juices. What I can affirm positively, on the basis of my experiments, is that human gastric juice, even when it contains two parts of free hydrochloric acid in a thousand, does not protect the digestive tract from tuberculosis.

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REVIEW OF CURRENT LITERATURE.

ON THE INFLUENCE OF HABITATION UPON THE SPREAD OF TUBERCULOSIS.

Romberg and Hædicke have studied in detail the influence of various conditions of life in dwellings upon the development of tuberculosis (*Deutsches Archiv für klinische Medizin*, Vol. 76, 4 & 5, p. 309).

According to Stadler of Marburg, the state sanatoria prolonged the lives of their inmates who had been in the first or second stage of pulmonary tuberculosis by an average of three years with the ordinary period of three months' treatment. This result shows that the public sanatoria are far behind the institutions which treat patients who are in better financial circumstances and who can be treated for a longer time. Even if Stadler's statistics are not exact, they are probably true in principle, and yet the state sanatoria are valuable weapons against the disease, especially against the economic damage which it brings to the indigent population. Sanatoria also are of great benefit through the educational influence which they exercise with all classes of the people. While they will improve the condition of many patients they can not be hoped to diminish the mortality of tuberculosis to any great extent. So, if we wish to diminish the spread of the disease and the ravages thereof, it is not enough to build numerous sanatoria. We must attack the problem from quite another side.

There is no question that tuberculosis affects for the most part the poor. All writers agree that the disease is more frequent in the less well-situated classes. Thus, for example, there were in Hamburg, according to Gebhard, 1.07 deaths from tuberculosis among 1000 taxpayers whose income was over 3500 marks annually; 3.93 per thousand from this disease among persons with incomes of from 900 to 1200 marks, and five or more deaths per thousand among persons with an income under 900 marks. No figures exist, however, which show the spread of tuberculosis in the various classes of the population of an entire community. The first question to be determined, therefore, is how many tuberculous persons are living at a given time in the various classes of the population.

The present authors made a study of the poorer classes of the population of a small city, Marburg, the great majority of which were treated

in the public clinic. The authors found that the statistics of tuberculosis in Marburg were very eloquent as to the frequency of this disease among the poor. The town of Marburg has about 18000 inhabitants, of which about 197 or 1.1 per cent. are affected with tuberculosis. Of these four-fifths were found in the poorest fifth of the population. Of 3527 persons belonging to this class, 167 were affected. While in this poorest fifth of the population 4.7 per cent. were affected, in the four-fifths of the population that were in better circumstances only 0.2 per cent. were diseased. These figures were computed from the death-lists of the town, and are slightly too low in all probability. It is possible that in other towns the contrast is not so great, but it is probably nearly the same.

The great frequency of tuberculosis among the poor has been attributed very often to insufficient and improper food, to the worry and care for daily bread, but above all to unfavorable conditions of life in the dwellings. A number of authors have investigated this side of the subject, especially Rubner, Cornet and Flügge, who found that opportunities for infection existed more frequently in the narrow quarters of the poor. Some authors—for example Rubner—also emphasized the bad hygienic effects of poor dwellings, especially on account of the dampness of the air therein. The lungs are at a great disadvantage in this atmosphere, especially with the usually bent position in which the poor work. The temperature of the body is then regulated chiefly through the skin and the inmates perspire easily, always they have damp clothes, and so are exposed to colds. Other authors decline to accept the theory that the poor are more prone to tuberculosis.

In view of the fact that a coughing patient who is not careful with his sputum and who lives in narrow quarters is dangerous to the persons surrounding him, a variety of measures have been suggested to diminish infection in tenements. Some special laws—the foremost of which are that of Norway, May 8, 1901, and that of Saxony, September 29, 1900,—are of great value in combating infection in tenements, but a firm in Altena, Germany, has attacked the evil at its root by establishing dwellings at the edge of a forest in which workingmen with tuberculosis must live and are provided with a separate room with an adjoining balcony for outdoor rest.

The methods of the New York Health Department are admirable in their thoroughness and energy and they were chiefly developed through the activity of Dr. Biggs. Every case of tuberculosis must be reported

and all cases in which the attending physician does not undertake to instruct the patient are visited and instructed by officials. If possible, the entire premises are thoroughly cleaned with hot soda solution, newly painted and papered, etc. After the patient moves away or dies, the premises must be renovated before they can again be rented. If the proper measures can not be adopted, owing to the conditions prevailing in the house, the patient is removed to a hospital, etc. Similar measures have been adopted in Germany and France. The modern tenement house reform movement will do a great deal to relieve the existing conditions in the dwellings of the poor.

The present authors studied with especial attention the data which underlie our knowledge as to the influence of dwellings upon the spread of tuberculosis. As a matter of fact, these data are very insufficient at present for any conclusion as to the influence of unfavorable dwelling conditions upon the spread of the disease. There is actually only one investigation of the dwelling question; namely, that of Biggs in New York, that is of positive value. Biggs found that in certain quarters of New York certain houses remained free from tuberculosis for years, while in others one case of consumption after another developed, and in still others cases of consumption occurred only occasionally. Houses inhabited by Chinese were especially distinguished by the frequency of cases of tuberculosis, while dwellings inhabited by Russian and Polish Jews were comparatively less frequently affected. In some houses, in which there was an average of from 27.6 to 36.3 inhabitants, there occurred, in the course of three years, from nine to eleven cases of tuberculosis. On account of this massing of the cases of tuberculosis in certain houses it may be seen that a large number of all the cases of tuberculosis occurred in comparatively few houses. Thus, in the fourth district, with 18,323 inhabitants and 663 houses, there was tuberculosis in 37.3 per cent. of all the houses. In 10.5 per cent. of all the houses there were observed 55.8 per cent. of all cases of tuberculosis.

Beyond these investigations of Biggs there are but few conclusive collections of data. Recently an important investigation was conducted by a large sick benefit association in Berlin (1903). The officials of this society found that 4.9 per cent. of their male patients and 8.74 per cent. of their female patients occupied only one kitchen, 19.34 per cent. of the men and 20.33 per cent. of the women only one room and 52.05 per cent. of the men and 45.73 per cent. of the women a single room and a kitchen.

These persons were alone in these rooms only one-eighth of the day and about one-thirteenth of the night, while the rest of the time was spent with others, for the most part with from two to four persons. In November 1902, out of 1012 patients, 229 did not possess a bed of their own, and in January, 1903, of 605 patients, 41 with tuberculosis lived in dark and damp rooms and 53 had to divide their beds with others. These conditions are not peculiar to Berlin, for the reports of the sick benefit societies in Strasburg and Magdeburg showed similar conditions. Thus, in Strasburg 80 per cent. of the families investigated lived in fewer than two rooms and a kitchen. Among these, 2524 persons had only 1269 beds, and in families of seven and over there was not even one bed to every two persons. Only about 13 per cent. of these people had their own beds. It must be remembered that the people who came under this investigation were members of a sick benefit association and that the conditions are far worse among people who do not belong to any such organization. These must also be investigated.

Biggs' statistics seem to be somewhat less valuable, because in an enormous city like New York the investigation of each case is almost impossible. It may be objected also that the occurrence of a number of cases of tuberculosis in the same house is a mere coincidence through the accidental congregation of families with consumptive members who sought cheaper dwellings on account of their smaller earning capacity. It is desirable, therefore, that the question of the dwellings be studied also in a small town in which every case can be easily investigated. For this purpose the authors studied the conditions obtaining in Marburg, from 1890 to 1901. The records of the public clinic were made the basis of the investigation. In one hundred and sixteen houses there were found 1963 persons, of whom 1193 were adults and 770 children under fourteen. In these dwellings the clinic treated during eleven and one-half years 1431 persons, some of them for periods of several years. Only a few families in these houses did not require treatment in the clinic during the eleven and one-half years. The dwellings in question were inhabited for the most part by about 16 persons, the lowest number being five, the highest 42. Tuberculosis was found in 262 persons, that is, in 18.3 per cent. of all patients treated in the clinics. Of the 547 persons over 13 years of age, 181 or 33.1 per cent. had tuberculosis. Of the 884 children below 13 years of age, 81 or 9.2 per cent. had consumption. Only about one-sixth of these houses in the poorest district of Marburg had no cases of tuberculosis dur-

ing eleven and one-half years, while Biggs found in some districts in New York only 37 per cent. of the houses riddled with tuberculosis and 63 per cent. free from the disease. The fact that tuberculosis could readily occur in the houses which had been free from the disease for eleven and one-half years was shown by the presence of cases in these dwellings before 1890. Yet, it is remarkable that in 20 houses with 294 inhabitants, of whom 191 had been patients at one time or other during eleven-and-one-half years, there was not a single case of tuberculosis. A closer study of the figures obtained by the authors shows that tuberculosis seems to be concentrated in a small number of houses in Marburg. Thus, in 33.6 per cent. of the houses occupied by the poorest inhabitants of Marburg, they found 59.2 per cent. of all the cases of tuberculosis in this class of people. If the number of tuberculous persons living at the present time in this district be considered, the prevalence of the disease in certain houses is still more marked. Thus in 2.6 per cent. of the 1503 dwellings of Marburg live about 34 per cent. of all the tuberculous patients; so that the figures given by Biggs are confirmed. The results of the author's investigation, therefore, showed that tuberculosis is "a disease of dwellings." A study of the houses in detail showed that there was nothing in the position, method of construction, or the density of population in the houses in Marburg which could point to a cause for greater or less frequency of the disease in any particular house. The dirt found in houses and rooms did not seem to have any influence upon the frequency of cases of tuberculosis, but it was noted that there were never many cases in neat houses and in clean rooms. The study of the cases among the children seems to point to the conclusion that in a great majority of cases infection is responsible for the disease. According to Nägeli a single infection with tubercle bacilli very often does not lead to a true tuberculosis. The authors found, in confirmation of this, that repeated exposure to infection, while living with a careless, coughing and spitting consumptive in a dirty dwelling, plays the most prominent rôle in the spread of consumption. Although it can not be denied that a single infection may produce the disease, if there are other predisposing factors, the great cause of the spread of the disease among the poor is repeated infection of the germs of tuberculosis, and to this must be attributed the fact that tuberculosis is massed in certain houses so as to be called "a disease of dwellings." The struggle against tuberculosis must be carried on, therefore, in the dwellings of the poor.

EHRlich's DIMETHYLAMIDOBENZALDEHYDE REACTION
IN THE URINE.

In the September issue of the *American Journal of Medical Sciences*, Chas. E. Simon publishes an article on the occurrence of Erlich's dimethylamidobenzaldehyde reaction in the urine. Erlich found that in various pathological urines, notably in phthisis, typhoid fever, and chronic enteritis, a fine cherry-red color develops on shaking the urine with a few drops of an acid solution of dimethylamidobenzaldehyde. Normal urines also produce the color, although much less intensely on the addition of heat, but at ordinary temperatures a distinct red color does not appear.

The first clinical report was made by Clemens, whose results in summary are the following: The intensified reaction, with which only, we have to deal, was never observed in health. It was most commonly seen in acute gastro-intestinal affections, and among these only in inflammatory forms, or those depending on tumors. Pure cases of gastritis and enteritis did not give the reaction, although three-fourths of all cases of common gastro-enteritis of the summer months gave positive results. Six out of nine cases of appendicitis were positive; also some cases of carcinoma.

Negative results were obtained in dilatation and ulcer of the stomach, in enteroptosis, non-tuberculous peritonitis, hepatic cirrhosis, intestinal tuberculosis, and acute intestinal occlusion.

Positive results were obtained in three of five cases of pneumonia; also in one case of acute febrile bronchitis; but the greater number of cases of bronchitis, acute and chronic, were negative.

Twenty-six cases of pulmonary tuberculosis were tested by Clemens, of which nine cases, all complicated by gastro-intestinal disturbances, gave positive results. Clemens refers in this connection to the observations made in cases of pulmonary tuberculosis by Dr. Engel, who found the reaction positive in acute gastro-intestinal disturbances and that the positive result was frequently simultaneous with a positive diazo reaction. But tuberculosis, *per se*, even febrile and in advanced form, does not necessarily call forth a positive reaction.

Simon considers important the observation of Clemens that all fæces, normal and abnormal, give a distinct bluish reaction of approximately the same intensity. As pure indol gives this reaction it is probable that the fæcal reaction is due to this cause. It is possible that the urinary reaction is identical; the urines rich in indican do not necessarily give it.

Kozoczkowsky, reporting from Senator's clinic, observed five cases of pulmonary tuberculosis and one of pulmonary tuberculosis associated with tuberculous peritonitis, and one of fibrinous pneumonia in which a positive reaction was present from the first observation till death. All the cases of tuberculosis presented the severe form of the disease, with rapid wasting; but especially high temperatures were not observed.

In a second group of five cases, the reaction was temporarily present. These comprised one each of fibrinous pneumonia, pulmonary tuberculosis, acute endocarditis, acute articular rheumatism, and scarlet fever.

Negative results were obtained by Kozoczkowsky in severe cases of pulmonary tuberculosis, two of splenic anæmia, three of subacute articular rheumatism, four each of acute diarrhœa, arthritis, neurasthenia, and constipation, and one each of gonorrhœal arthritis, erysipelas, acute articular rheumatism, angina, endocarditis, chronic bronchitis, diabetes mellitus, traumatic neurosis, influenza, hepatic cirrhosis, carcinoma of the liver, carcinoma of the stomach, angina pectoris, tabes and tertiary syphilis.

In attempting to ascertain the relationship between the occurrence of reaction and the degree of intestinal putrefaction Kozoczkowsky also made parallel indican examinations, but was unable to establish any definite relation.

Experiments to ascertain the influence of increased tissue waste upon the reaction yielded no results. Kozoczkowsky failed to obtain the reaction in the œdematous fluid of a patient whose urine gave a constant positive reaction of marked intensity.

In his own experiments Simon used a two per cent. solution of dimethylamidobenzaldehyde in equal parts of water and concentrated sulphuric acid. A few cubic centimetres of urine in a test-tube were treated with five to ten drops of the reagent. The mixture is set aside or agitated for a few minutes. Normal urines turn yellowish green or the normal color merely is intensified. Like Clemens and Kozoczkowsky, Simon considered no reaction positive except when distinctly cherry-red. The reaction he never observed in health. In his observations no heat was applied.

The urine should be fresh, certainly not over twelve hours old, for the substance causing the reaction is evidently very unstable and readily decomposed, and all attempts at preservation have been thus far futile. It is noteworthy that formalin will prevent the occurrence of the reaction, therefore by adding a few drops to a small quantity of the urine to

be tested a convenient control-test can be made, in doubtful cases. The intensity of the red color is variable—sometimes it develops instantly—again not until after two to four minutes. It is not usually safe to wait longer than five minutes, as the color disappears on standing and is replaced by the more common dark amber.

Simon observed no single disease in which the reaction was present in every case, and even in one and the same individual the reaction was not constantly present. He gives a list of conditions in which positive results were obtained; also of conditions which gave negative results, both corresponding quite closely to those of Clemens and Kozoczkowsky. A comparison of the positive and negative lists will show at once that not all cases of pulmonary tuberculosis, tuberculous hip-joint disease, pneumonia, typhoid, appendicitis and icterus gave positive results. As to tuberculosis it seems that the reaction is more likely to occur in the actively progressive cases than in the more or less stationary cases. Positive cases almost all gave positive diazo-reaction, but there is no ground for belief that there is any interdependence between the two. While the reaction was seen very frequently in pneumonia its presence was no index of the severity of the disease. Elevation of temperature or pulse has nothing to do with the appearance of the reaction, nor is cyanosis, *per se*, a causative factor. As a matter of fact, there was no single factor which was constantly present and common to all cases.

Simon gives as his impression that the reaction is most likely to occur in those conditions in which there is a marked and rapid destruction of tissue-albumins, and cites, in support of this opinion, a case of traumatic neurosis associated with such destructive changes. In this case there was no fever, gastro-intestinal disturbance or cyanosis. The one controlling factor of the case was the rapid and progressive loss of flesh. While this was going on the reaction was present. Later when the nutrition of the man improved it was absent. A case of icterus in which there was a positive reaction corresponded in a general way to the previous case.

In summarising his clinical results the author concludes that:

1. The benzaldehyde reaction does not occur under normal conditions.
2. Positive reactions are most commonly obtained in tuberculosis.
3. The reaction is also seen in non-tuberculous cases, both febrile and non-febrile.

4. It is not dependent on the presence of the body which gives rise to the diazo reaction.

5. For its production, elevation of temperature, gastro-intestinal disturbances and cyanosis are not essential.

6. Common to all cases seems to be an increased catabolism of tissue-albumins. As regards the chemical reaction which takes place it is likely that the aldehyde groupe reacts with a methylene or amido group of a still unknown constituent.

All attempts at isolation of the urinary constituent have so far not given satisfactory results. The red pigment, however, has been isolated by Pröscher, who obtained a substance represented by the formula, $C_{16}H_{24}O_6N_2$.

DISTURBANCES OF SENSIBILITY OF THE SKIN IN DISEASES OF THE LUNGS, ESPECIALLY IN TUBERCULOSIS.

Rudolf Goldmann (*Beiträge zur Klinik der Tuberkulose*, Vol. 1, No. 4, p. 361) studies in detail the changes in the sensory functions of the skin in pulmonary tuberculosis. Every physician knows how frequently tuberculosis patients complain of pain. Every patient has a different description for his pain, and a different location for it. A number of authors have devoted space in their treatises to the various localizations and to the different varieties of pain felt in tuberculous affections of the lungs. Head states that the region of the reflected pain corresponds to the zones of herpes zoster. Inasmuch as the ordinary seat of the affection in herpes is said to be in the spinal ganglia, or even in the spinal cord itself, and inasmuch as the distribution of the zones does not correspond to that of the nerves, Head refers the reflected pain not to the peripheral nerves, but to the spinal cord. He believes that the reflected pain occurs somewhat as follows: In tabes an irritation which is applied to an area of skin which has diminished sensibility is reflected into a neighboring portion with normal or increasing sensitiveness. In the same way an irritation which occurs in an affected organ is projected into that portion of skin which is supplied by the same segment of the spinal cord as that diseased organ. As a stronger stimulus lowers the resistance of the spinal ganglia-cells, an irritation on the skin in that area is more acutely felt, and so a cutaneous hypersensitiveness to pain and temperature is created. According to Head, the skin does not suffer any changes as regards tactile sensation.

Affections of the lung produce changes in certain definite zones of skin of the neck corresponding, according to Head, to the third and fourth cervical segments; that is, involving the skin of the neck down to a line drawn from the level of the shoulder, vertically downward to the spinal column, and extending forward on the neck to the posterior border of the sterno-cleido-mastoid and downward to below the clavicle. On the trunk are affected the zones corresponding to the region from the third to the ninth dorsal, i. e., the region which begins behind at the level of the shoulder-blade down to the twelfth spinous process and in front from the third rib to the navel. In the latter region there are also sensitive points developed in affections of the stomach, intestines and liver, so that the region below the ensiform down to the navel cannot be used in the diagnosis of lung lesions. "Head-zones" are circumscribed spots on the skin of the scalp in the region of the eyebrows, the temple, the forehead, etc., which are sometimes characterized by sensitiveness in lung affections.

The present author investigated the data given by Head, employing a very large number of patients in the medical clinic at Munich, whom he observed for a year and a half. These patients were in all stages of tuberculosis, and the sensitiveness of their skin was investigated in each case after another physician had determined the conditions of the lungs. Patients with deficient intelligence were excluded, as well as those who were too greatly susceptible to suggestion and those in whom there were complications on the part of other organs. The sensibility of the skin was tested with the head of a pin, sometimes with the point, or with the wood in case of a pencil, with a finger cot or a wad of cotton, as a rule beginning with the less marked irritation and gradually increasing to the stronger stimulus, according to the sensitiveness of the patient. The sense of temperature and the electric sensibility of the skin were also tested. As a rule, the tests were made, beginning with the normal area and gradually entering the abnormal.

A number of cases are reported in detail by the author. He found on studying these cases that the following conditions obtained: in tuberculosis of the upper lobe there is an increased sense of pain in the skin over the area of this lobe, with a maximum point of tenderness in the supraspinous fossa. The fact that this region extends, in many cases, downward below the margin of the upper lobe is due in all probability to a beginning affection of the upper portion of the lower lobe, which can not

be shown on physical examination. This interpretation is especially valid in those cases in which the lower portion of the sensitive area is most markedly affected. The spread of the pain upon neighboring regions such as the neck, the back of the head or the "head-zones" is to be interpreted through the tendency of the pain to radiate. Neuralgias in the areas noted may sometimes be due to affections of the apex. These neuralgias increase in severity in proportion to the pulmonary lesions and to the rise of temperature, and so they are worse in the evening and at night. In affections of the lower lobe the reflex pains are very distinctly outlined, the lower lobe moves more markedly in respiration and therefore there is more opportunity for the development of reflex pain, which is caused largely through the tension to which the diseased tissue is subjected. Possibly the careful avoidance of all respiratory motion is the result of this condition in cases in which a complicating pleurisy may be excluded. In a series of cases of chronic tuberculosis with old lesions the author confirmed the observation of Head that in such cases the reflex pain is absent, or at least very much less intense. The author could not confirm the theory of Head that in an affection of the pleura there was only local pain on pressure in a circumscribed area in the intercostal spaces, but he could not disprove it, because it was so difficult to decide in the dispensary patients whom he examined, whether the pleurisy existed alone or as a complication of the pulmonary disease; whether it was fresh or old.

As the result of his investigations, the author concludes that Head's zones exist, as a rule, in all acute affections of the lungs, and also in all acute, more rarely in subacute, exacerbations of chronic affections of this organ, although they can not always be proved to extend to the limits which this author outlines. The present author excludes the less frequent affections of the lungs, abscess, gangrene, tumors, syphilis, etc. Old foci and cavities without reactive inflammation, acute and chronic bronchitis, and very probably catarrhal pneumonia and inflammations of the pleura are not accompanied by spinal hyperalgesia of the skin. This phenomenon corresponds to the side and location of the disease. It may extend to the other side symmetrically, or it may extend beyond the limits of the lesion by radiation in the presence of a lower resistance of the conductivity of the nerves as the result of a moderate fever, a bad nutrition, and a nervous disposition. In hysteria there may be a hypersensitiveness over the entire half of the body, but in these cases the region

of the skin corresponding to the diseased areas is distinguished from the rest by its greater sensitiveness.

The hyperalgesia increases, other things being equal, according to the progress of the disease, but it may persist after the other symptoms have disappeared. Often it is kept up by very slight local changes for weeks, although the spontaneous pains have disappeared. In these cases we must assume the presence of an increased irritability in the spinal cord which only gradually disappears. In nervous individuals this sensitiveness to the pain may increase to a spontaneous symptom and the spinal phenomenon becomes a cerebral one. The zones are usually affected in their entire extent, although every portion of each zone is not equally affected. In such cases it is easy to distinguish the most sensitive part, if one does not always compare a symmetrical portion on the other side. As regards the boundaries of these areas, the author found them quite sharp in some cases, and rather indistinct in others, and in some instances they seemed to change at different examinations. According to Mackenzie, the deeper layers of the skin are affected by this hyperalgesia, but the present author supports the view of Head that there is no deep pain on pressure, and he tested this by examining the deeper layers of skin after moving to one side superficial layers over the point to be examined.

The examination for pain on pressure in circumscribed pleurisy is of value only when the intercostal spaces are wide enough, as otherwise the soft parts are pressed against the sharp edges of the ribs. The author could not find with certainty in each case the maximal points of tenderness in each zone as given by Head, and he believes that it is very difficult to show these points on account of the unequal sensitiveness of various portions of the skin. He found, however, that the most sensitive points were very often situated in the supraspinous fossa, in the hollow beneath the clavicle and in the pit of the stomach about midway between the ensiform and the navel. It is not astonishing that the patient's statements as regards the sites of sensitiveness were not always exactly the same, especially when some time had elapsed after the last attack of pain. It very often happens that the pain is referred exclusively or principally to the abdomen or to the posterior zone. It is important never to draw the attention of the patient to the objective finding which is expected, but to stimulate him to express his own feelings. The author does not confirm the statement of Head to the effect that the area supplied by the fifth, sixth, seventh, and eighth cervical segments (i. e.,

the skin of the arm with the exception of its inner surface) constitutes an interval in which there is no sensitiveness in the presence of internal disease, for he observed in several cases of disease of the heart and lungs that the zones described were affected. He confirms the ordinary upper and lower limits of sensitiveness affected in lung disease, as given by Head, but finds that the lower limit extends somewhat further down to the groins. A number of corrections will be necessary in the future in the number and extent, as well as the shape, of Head's zones. The zones of the head occupy a peculiar position. It is not astonishing that such zones should exist, when one considers that the trigeminus derives some of its fibres from the cervical region of the spinal cord, and so, that the irritation of an affected apex is transmitted from the lower cervical segments to the upper and thence to the region of the trigeminus. It is very possible that a great many cases of so-called trigeminal neuralgia are symptoms of a pulmonary disease. Unilateral affections of the sympathetic, especially of its thoracic portion, as the result of a diseased apex may cause migraine as a symptom of the pulmonary disease. But in such cases there are, for the most part, vaso-motor and ocular phenomena.

Cornet has called attention to the sensitiveness of the spinous processes and of the sternum in diseases of the lungs. Petruschky regards pain in the region extending from the second to the seventh dorsal vertebræ as a nervous symptom of tuberculosis of the apex, produced by the affection of bronchial lymph-nodes(?). Faber explains this pain as a part of a general hypersensitiveness of the skin, and on the other hand as an independent symptom when it occurs outside of Head's zones. Trousseau's apophyseal sensitive points in intercostal neuralgia, which must now be considered as reflex evidences of a visceral lesion, as a rule correspond to the spinous processes belonging to the affected roots. It is only occasionally that points of sensitiveness are found outside of the affected zones, and in these cases there is probably a radiation of the sensitiveness. The author found sensitiveness in the median line of the body, especially in patients in whom there was radiation to the other side, and less frequently in those in whom the sensitiveness was limited to one side of the body.

As regards the frequency of hyperalgesia in relation to sex, there were 19 women and 21 men among the 40 patients with a distinct sensitiveness. While there is a distinct tendency of the reflex pains to extend and to radiate in hysterical patients, yet Head's zones are by no means

signs of a tendency to hysteria. The sensitiveness due to lung affections must be differentiated from intercostal neuralgia. In the latter case the pain occurs chiefly on pressure upon the nerve trunks; not so much spontaneously or as a result of irritation on the skin. In muscular rheumatism the sensibility of the skin is not altered, nor is it in affections of the joints, except in cases in which the joints are full of fluid, where the skin is even less sensitive than normally. The distinction between hysterical sensitiveness of the skin and that due to affections of the lungs is made by observing the peculiar shapes of the areas of sensitiveness in the former; e. g., shapes corresponding to amputation flaps in limbs, etc., and also by the existence of other characteristics of hysteria.

The chief value of Head's zones is in diagnosis, and the author believes that their delineation may assist in locating pulmonary lesions.

THE DIAGNOSIS OF TUBERCULOSIS OF THE LUNGS.

O. Roepke, of Lippspringe, Chief Physician to the Second Sanitarium (*Beiträge zur Klinik der Tuberkulose*, Vol. 1, No. 3), reviews the history of tuberculosis in its relation to the diagnosis of this disease. From the beginning of the 18th century to the year 1882 was a period which might be called that of the physical method of examination, when the diagnosis of the disease was based entirely upon the clinical examination of the patients. In 1882, when Koch discovered the tubercle bacillus, began the period of bacteriological diagnosis, and for a time it was thought that it was no longer necessary to examine the patient's chest by the means of physical diagnosis which had been worked out and cultivated by the older clinicians. Very soon, however, experience taught that it was very often impossible to find the tubercle bacillus, although a tuberculous process was going on in the lungs, and so a combination of the physical and bacteriological methods was adopted, which is in use today in the "period of early diagnosis."

In the present period certain other means of diagnosis have been added to our resources in distinguishing the presence of this disease at the earliest possible moment of its development. The most important of these are the use of the X-rays, the determination of the blood pressure, the measurement of the temperature after exercise, the blood-count for leucocytosis, the presence of albumin alternating with an excess of

phosphates in the urine, the appearance of an artificial catarrh after administration of iodine, the examination of the sputum by means of animal experiments, the presence of agglutinations, etc. The author thinks that all these scientific helps, which have been so highly recommended of late as means to an early diagnosis, fail in most instances to be of any assistance and require an amount of time for their execution which no busy physician can give. On the other hand there are other methods which the practical physician can use with success without great loss of time.

Of these the most thorough and the most elaborate as well as the most trustworthy method of diagnosis is the tuberculin reaction. The latter, however, forms only a link in the chain of all the means which have been found, from the time of Hippocrates to the present, for the diagnosis of this disease. It is a mistake, therefore, to use the tuberculin test alone and not combined with the other diagnostic methods, thus introducing an "era of tuberculin diagnosis." If this test was used in all cases without any regard to the clinical findings in the lungs, to the general condition of the patients, and to the possible presence of complications, a great deal of harm would result, and so discredit would be brought upon a method which is, at best, feared by the layman, but which is invaluable in the hands of an experienced and careful diagnostician.

In order to show the value of the different methods of diagnosis, the author analyses a series of 399 cases in which he conducted the examination personally.

A most thorough method of investigating each case in detail was given. Under the heading of personal data the age, the social condition, the occupation, the material circumstances of each patient were noted. The data of a clinical history taken from the patient's statements are of great value in the diagnosis of tuberculosis. Some physicians, even some specialists, disdain to take a personal account from the patient, because they are driven to haste and to slovenliness by a waiting-room full of patients. It is true that in the presence of an advanced tuberculosis in the third stage, a history of the case is not of very great value for the diagnosis and prognosis. But even in the second stage, which can be made out without any trouble by clinical examination, a history serves as an aid in making the prognosis. A history is of especial value in all those cases in which a forecast of the patient's future is desired on ac-

count of marriage or other plans for the patient. In all these cases the history is of great assistance in judging as to whether the process is progressing, retrogressing or standing still, and the consideration of the clinical history will often save the examiner from serious mistakes.

In the state of our present knowledge of the disease it is no longer sufficient to make a diagnosis of "consumption pure and simple," but in examining a patient for admission into a sanitarium we must distinguish the degree to which the process has involved the system and the extent to which the curative attempt might be successful. We must also be able to tell whether the patient will regain, through an appropriate treatment, his full capacity for work or only a fraction of this capacity. In other words, we must distinguish whether a patient is still suitable for the sanitarium or whether he is no longer a fit subject for this treatment. In the early stages, when history is of great value in diagnosis, especially in making out those initial forms of the disease which begin in the apices of the lungs and which puzzle at times the most experienced examiner, in making a differential diagnosis, for example, between bleeding from the lungs and hæmorrhage from the stomach, between a cavity in the lower lobe and a bronchiectasis, etc., a detailed history is also of value in another sense, especially in hospitals and sanatoria. The facts about the patient's life, his childhood, his youth and his mode of life give us a picture of his character, of the degree of his intelligence, of the mental attitude of the patient, all of which are valuable in the diagnosis and prognosis of a chronic disease. When a careful personal history is taken, the patient realizes that he is being treated as a human being, not merely as so much clinical material, and this impression is very important for the successful treatment of a case in an institution. Besides, the clinical history, if carefully taken, in many cases gives us data which are of great value for comparative study, and which may assist in solving many questions in the field of tuberculosis, especially as regards heredity and acquired predisposition.

The author gives in detail the statistics of the family histories of the 300 patients observed, with reference to the question of heredity. He found that only 21.8 per cent. of these patients showed any tuberculosis in their parentage. In 60 per cent. of these cases the father was affected, and in only about 30 per cent. the mother. This shows that the male portion of the population in the district studied was more exposed to infection owing to occupation than was the female element. The health

of the brothers and sisters was noted in all cases. The 65 patients who gave positive family histories had 280 sisters and brothers and the 233 patients who did not show any tuberculosis in the family had 1041 sisters and brothers. Therefore, there were for each patient who was born of a healthy marriage 4.5 brothers or sisters, while for each patient born of a tuberculous marriage there were 4.3 brothers and sisters. These figures do not support the view which is generally held, that persons affected with tuberculosis are more prolific than healthy persons. In comparing the number of healthy children in families in which the parents were tuberculous with the number of such children in non-tuberculous families among the 300 patients, there was no appreciable difference between these two classes. The slight excess of descendants of healthy marriages was characterized by healthy offspring, but there was no increased figure for morbidity or for mortality among the children of tuberculous parents.

As regards the health of the mothers the author found that 7 per cent. of the wives were affected with the same disease as their husbands. In the marriages in which the husband was of the third stage in tuberculosis, 9 per cent. of the wives were affected. All the tuberculous women had children. Of the 172 married patients, 12, or 6 per cent., had no children. Of the 160 other marriages, 519 children were born, of whom 457 were healthy, 38 had been stillborn or died of other diseases in later years, and 24 were tuberculous. The proportion to each marriage was 3.3 children, of whom 2.9 were healthy, 0.25 died and 0.15 were diseased. The fathers who were in the second stage had the greatest number of children and the greatest number of healthy children, the fathers in the third stage had the fewest children, while the fathers who were in the early stage had the mean number of children. The number of tuberculous children increased progressively with the degree of the tuberculosis of the father, and the number of stillbirths in the families in which the husband was in the third stage was very high.

The previous history of the patient must include all his diseases from childhood to the beginning of the present illness. The statistics of the author's cases did not confirm the theory that children born late of parents with numerous offspring were predisposed to tuberculosis. Of the total number of patients, 30.2 per cent. were first children, 21.7 per cent. second children and 19.3 per cent. third children; in other words, 71.2 per cent. of the patients were among the first three children of their

families, while the average number of children in these families was 5.3. The number of patients without hereditary history, who had been healthy in childhood, was greater by 2 per cent. than the number of those who had tuberculosis in their families. Statistics of the military examinations among the 300 patients showed that 50 per cent. of the men were declared ineligible while only 28 per cent. were found eligible and the remainder had not been examined. These figures show how necessary it is, in the interest of military service, to prevent tuberculosis.

In all cases the question as to whether their occupation had any influence upon their disease was answered in the affirmative. On the other hand, all possible predisposing causes that might have been created by the patients themselves were denied. Not one admitted the abuse of alcohol or excess in venery, but a few admitted excessive smoking and bicycle riding. The study of the material circumstances, the food and the conditions of living of the patients offered a number of points of interest, but as they would not apply to the United States they are purely of local interest.

In answer to the question as to the possible source of infection, the author obtained 71 definite replies. In 16 cases a family infection was traced to the parents, in 23 cases to brothers or sisters, in 3 cases to the wife. Infection through occupation was traced in a number of cases. Thus, in two instances the infection seemed to originate from documents handled by clerks in a public office. In two other cases the tuberculosis was acquired by nurses who attended tuberculosis patients. In 19 cases the sources of infection were fellow workmen, evidently consumptives who expectorated indiscriminately. The author thought from the data that he obtained, that Flügge's droplet infection from members of the family was more frequently the source of the disease than the inhalation of dry dust.

The second portion of the history related to the previous diseases of the patient, as well as to the statement of the present illness. The physical examination followed, then came the examination of the sputum for tubercle bacilli and finally the tuberculin test. It would lead us too far in the present review to give all the details of the cases analyzed by the author, but in every instance he dwells upon the necessity of making an early diagnosis, and believes that both percussion and auscultation are equally important in the early diagnosis of the disease, especially when both methods show deviations from the normal in the same area. While the

presence of tubercle bacilli in the sputum is the most trustworthy sign of tuberculosis, yet it is of no great value in the early diagnosis of the disease, and the practicing physician should not wait for the appearance of these germs in the sputum before he makes the diagnosis. The tuberculin test should be used only in the doubtful cases and is most effective when the doses used are not too small. (From 1 to 10 milligrammes.) This test should be used in all public institutions, when the repeated examination of the sputum is found to be negative or when there is no sputum expectorated. In all cases, however, we must judge the results of both sputum examinations and tuberculin tests in the light of the clinical findings.

ON DIAGNOSTIC INJECTIONS OF TUBERCULIN AND THEIR APPLICATION TO SANATORIUM PATIENTS.

Hammer (*Beiträge zur Klinik der Tuberkulose*, Vol. 1, No. 4, p. 325) contributes an extensive study on the value of tuberculin as a means of diagnosis. He says that the modern methods of treating the disease have made an early and infallible diagnosis of this infection more necessary than ever. The early diagnosis of tuberculosis today is not only of importance to the physician and to the family of the patient, but is also of great weight as a matter of public health. Although we cannot say definitely, as yet, how much good the public sanatoria can do, there is no question that only the earliest stages of the disease are suited for treatment in these institutions. The difference between the private sanatoria and the public institutions is that the latter are founded for the welfare of the community at large, not for that of the individual only. The time during which a patient can be treated in a public sanatorium is naturally limited. The aim is to obtain a certain favorable result within an average of three months, and therefore it is necessary, in view of the nature of the disease, that only the earlier stages of it be treated in the public sanatoria.

In a great many cases, however, it is very difficult indeed to recognize the earlier stages of the disease, and unfortunately it occurs very often that the existence of consumption is suspected but cannot be proved. Under these conditions, the adoption of an exact method of early diagnosis is of great value and in this connection no method deserves more attention than the tuberculin test. Unfortunately, the prejudice which

has been created during the first tuberculin period against the use of Koch's method has given rise to a great antipathy, both among physicians and laymen, against the employment of tuberculin injections. The dangers which are connected with the use of tuberculin have been greatly exaggerated, for they are entirely out of proportion to the advantages of this method. These dangers, it is true, forbid the general use of this method and limit its application, so that it cannot be always applied for the purposes of admission to the sanatoria. The difficulties and the time required for the diagnosis by tuberculin are insignificant, when compared to the advantages of a positive diagnosis. Unfortunately, it is as yet impossible to adopt the method which some authors advocate, i. e., before admitting a patient to a sanatorium, to keep him under observation in a hospital where tuberculin may be applied with all the precautions necessary and with the proper accuracy. Yet, the tuberculin injections can very well be used in walking patients in a dispensary. During the past two years this method of diagnosis has been employed by the author in the Heidelberg Policlinic in the following manner:

The patients are first instructed in the method of taking their temperature. This instruction is given by a nurse. The temperatures are measured every four hours during the day and are entered by the patients into properly ruled copy books which they always carry with them. Although it is desirable that these measurements be made every two or three hours, day and night, yet, under the circumstances, the author has abstained from such a rigid requirement. If the patients are annoyed by too frequent measurements the accuracy of their observations will suffer. Most patients readily learned the method of measuring their temperature, but sometimes the tests had to be given up, on account of the impossibility of training the patients to make accurate observations.

Measurements of temperature, executed every four hours, are perfectly sufficient to judge the variations induced by the diagnostic injections. If the measurements were found to be correct, and if the temperature had remained normal for eight days, the tuberculin injections were begun, and two further measurements of temperature, one at six in the morning and the other at ten at night, were introduced. If however, the fever persisted, the treatment was directed toward removing it. For this purpose aspirin was given in doses of 0.5 g. three times daily, or occasionally 1.0 g. twice daily. This remedy was found to be superior to pyramidon for the purpose in view. If the measurements showed a faulty

record no tuberculin injections were given until eight days had passed without fever and without a suspicion of a mistake in measurement. During the first few days of observation a short clinical history was written in each notebook containing the record of temperature. In this history were noted the physical signs found in the lungs at the first examination, as well as the reactions observed from the use of the tuberculin injections. In case these reactions should be too marked, the patients were instructed to send for the district visiting physician, but this was almost never necessary.

When the injections were begun, each patient received a bottle for the reception of the sputum which had been found free from tubercle bacilli before the reaction. In this was collected the entire amount of sputum expectorated after the first injection, until the next visit. One class of patients in whom the injections were used were persons in whom the physical signs were perfectly plain, but no tubercle bacilli had appeared and the general symptoms were as yet in abeyance. In such cases the use of the tuberculin reaction caused the patients to realize that they were affected and that tuberculin injections were necessary. Another class of patients in whom these diagnostic injections were very valuable were those in whom there were no objective signs whatever and in whom the presence of general symptoms made one think of the possibility of consumption and also patients in whom the physical signs were so slight that doubts arose as to the presence of a pulmonary disease.

The injections were given twice a week so that there were always two or three days between two injections. The doses given by Beck were used, as a rule, because they proved to be the most satisfactory. According to this author 0.001, 0.005, 0.01 were successively injected at short intervals, the last dose being repeated if the reaction was found insufficient or absent. For diagnostic purposes this "typical" dosage seems to be the most successful. At the beginning of these tests when the unfavorable experiences of the early tuberculin period were still fresh, smaller doses were used in the ambulant cases, especially in those in which the general condition made one suspect that the reaction would be very marked. In such instances the doses were, first 0.001, then 0.003 and 0.006 and lastly 0.01. This last "milder" method of dosage gave about the same results as that of Beck. After the reaction had set in the temperature was measured as before, every four hours, until at least

eight days had elapsed during which the patient was free from fever, when the diagnostic test was considered finished.

It must not be forgotten that in this method of injection in dispensary patients, we are placed at a great disadvantage through the fact that the patients do not come to us at the height of the reaction, but generally present themselves when the acme of the reaction has passed. On this account, it must be admitted, that certain phenomena of reaction evade our observation. But this does not mean that the occurrence of a positive reaction escapes the observer under these circumstances.

As regards the technique of injections, the usual rules are to be observed. In the first place there must be a thorough disinfection of the site of the injection. The best location for these injections were found to be the suprascapular or interscapular regions, if for no other reason than because they are so easily accessible in the dispensary. Overlach's syringes, made of glass with asbestos pistons, bearing an accurate graduation, were used for these injections and were always boiled before being used. The asbestos piston suffers from this boiling, and must be renewed very frequently; it must fit very accurately. Koch's old tuberculin was used in all instances and the following solutions were employed:

1. 0.01: 10.0 of 0.5 per cent. carbolic acid in water (1-10 of the contents of a syringe holding one c. c., i. e. usually one division of the scale, corresponds to 0.0001 of tuberculin).

2. 0.1: 10.0 (1-10 equals 0.001 of tuberculin).

3. 1.0: 10.0 (1-10 equals 0.01 of tuberculin).

The solutions were kept in a cool dark place (in the summer in the ice chest) and a careful lookout was kept to see that they did not show any flocculent precipitate. In this manner the solutions could be kept unchanged for a considerable time, certainly for fourteen days or longer. At any rate, no disturbances were observed in any case which could be attributed to a decomposition of the injection fluid.

The author analyzes a series of 180 cases in which he has used tuberculin injections for diagnostic purposes in the manner prescribed. Of these 180 cases 164 showed positive reactions (91.1 per cent.) and 16 showed negative or doubtful reaction (8.9 per cent.). There were 462 injections given in all, an average of 2.6 per cent. injections for each person. In 25 patients a single injection of 0.001 of tuberculin was sufficient to obtain a reaction. Of the total number of patients injected 130 were in the first stage of the disease. These showed either only qualitative

changes in the respiratory sounds, or râles in one or both apices, or in some instances a qualitative change in the percussion sound. In 8 patients there was a more advanced stage of the disease, which would correspond to the second stage of tuberculosis according to Turban's division. One patient was found to be in the third stage. In 41 cases there were no pulmonary symptoms whatever but only general signs which pointed to the possibility of a latent consumption. Of the 130 patients belonging to the first stage, 63 were injected according to Beck's or the typical method; of these 59 were positive, and 4 negative or doubtful. Of the remainder of these early cases 49 received injections according to the milder method of dosage. Of these 46 were positive and 3 negative or doubtful. In 18 cases a single injection was sufficient. Of the cases in the second stage the typical method of injection was used in three, of which all were positive; the milder method in two, both of which were positive. A single injection was sufficient in four of these cases. Of the 41 cases in which a definite objective result could not be obtained on examination, 15 received injections according to the typical method, of which 10 were positive and five negative or doubtful. The "milder" method was used in 23 of these with 19 positive and 4 negative or doubtful results, and in three a single injection was sufficient. The figures quoted above show that there is no appreciable difference in the results obtained with the method called "typical" and that styled as the "milder" one. But it must not be forgotten that these methods were employed according to the severity of the disease as it was deduced from the appearance and behavior of the patient. A positive opinion can not be expressed, therefore, as to the reactive merits of these two methods, especially as the number of cases was so small. It must be noted, however, that in the use of the "typical" method in the dispensary no specially marked reactive disturbances were noted, while the use of the "milder" method did not seem to protect the patient from the ordinary accidental effects of tuberculin. Nor could an appreciable difference be found between the two methods as regards the severity of the reaction, and even the cases in which only a single injection of 0.001 was sufficient, did not show any different results as compared to those treated with higher doses.

The normal temperature was calculated for each patient from the average of the highest and lowest daily temperature of the normal temperature period which lasted at least eight days before the first injection. Rises over this normal average were considered as constituting a patho-

logical reaction only when the temperature exceeded 37.5°C . The smallest variation from the normal temperature which was regarded as a result of a pathological reaction was 0.8°C . The temperature relations of each case during reaction were carefully studied by the author. The following figures in each instance represent, first, those applying to the cases injected only once, the dose being 0.001; second, the figure applying to the cases injected by the "milder" method, and third, the figure applying to those injected by the "typical" method. The beginning of the reaction took place on the average after 15.4 hours in the first class, after 11.3 hours in the second class and 13.5 hours in the third class. The height of the reaction was reached in the first class after 31.6 hours, in the second class after 21.6 hours, in the third class after 20.5 hours. The duration of the reaction was 43 hours in the first class, 54.5 hours in the second class and 35 hours in the third class. The extent of the rise of temperature was 1.7°C in the first class, 2.0° in the second class and 2.1° in the third class. In all cases these figures represent the average for each class of patients. From these figures, which are taken from a comparatively small material and which therefore can not be used for general conclusions, the author makes a provisional deduction that the smaller the dose the later and more gradual is the reaction, and the later is the height of the reaction reached.

Of the 180 cases only 16 were negative or doubtful in their behavior towards the tuberculin reaction, but this is a comparatively high proportion when we consider that the injections were given almost exclusively to persons who were at least suspected of tuberculosis. Of these 16 negative cases 7 showed no trace of any effect after the injection. In one of these patients tuberculin had been used a year previously as a mode of treating his tuberculosis, and the diagnostic injection was given because the patient had begun to cough in connection with an attack of influenza, although the physical signs in the lungs had undergone no change since the time when he was treated with tuberculin. In this case there was a certain degree of immunity of the organism against the effect of tuberculin, but even if this be admitted it is possible that there was a simple bronchitis and that there was no fresh tuberculous process, an assumption which was justified by the subsequent course of the disease. In the other nine cases, a slight influence was found to result from the injections as regards the height of the fever, consisting in a rise of the curve to 37.5°C , at times to 37.6°C . This rise occurs as a rule on the same day that the in-

jection is given, only exceptionally on the following day, and consists of a single elevation of the curve, which sinks to the normal almost immediately. Only in one case was there a rise of temperature continuing for three days and extending to a few tenths of a degree up to 37.4°C , while the injection of larger doses had no effect whatever on the temperature. In the cases in which a definite reaction was obtained, the following symptoms were observed. The reaction began with a chill, followed by an intense feeling of heat, and often by profuse perspiration. Occasionally, instead of the pronounced chill, there was only a slight chilly sensation alternating with a feeling of heat and in these cases the perspiration was slight. At the same time or even before this, there came a general malaise, sometimes a very pronounced prostration with severe headache which involved sometimes the entire cranium, sometimes the forehead and sometimes the occiput. Sometimes only a feeling of pressure and fullness in the head was complained of. According to the strength of the reaction, the feeling of prostration was spoken of in the lighter cases as one of weakness, and in the more severe cases it increased to an absolute impossibility to walk or to stand erect. This symptom was sometimes preceded by a more or less marked vertigo. Very often there was a marked feeling of weakness accompanied by severe pain in the entire body, and pains in all the limbs. These symptoms are very much like those of a severe influenza, and very often the patients themselves say "I feel as though I had the grippe."

In rare instances there were slight symptoms of collapse, or a complete loss of consciousness. The general appearance of the patient corresponded with these symptoms. The patient looked haggard, his eyes were sunken, etc. But, on the other hand, there were cases with very pronounced reaction in which the patient's appearance was very slightly affected, so that one could not tell that they were in a state of febrile reaction. In most cases, even the severest symptoms were overcome in a very short time. The patients as a rule suffered from sleeplessness or from an uneasy sleep which was accompanied by a general irritability. In rare cases there was general loss of consciousness with delirium at the acme of the fever. Among the general symptoms must be mentioned the loss of appetite which is almost constant; for but rarely does the appetite remain unchanged, even in cases with slight reactions. In one case the appetite was even increased considerably, although there was a marked reaction. Nausea and vomiting occur with moderate fre-

quency and sometimes there are complaints of pressure and pain in the stomach, symptoms which sometimes occur without loss of appetite, nausea or vomiting. At times there is a more or less complete and protracted loss of the sense of taste with the loss of appetite, a symptom which occurs not infrequently in influenza. In some cases there is a general abdominal pain with or without diarrhoea, and sometimes there is constipation. At times there are swellings of the spleen which are painful, and in rare cases swellings of the liver. In one case there was a sensitive spot in the region of the flexure; in another case in the region of the appendix. Disturbances on the part of the bladder were not often observed. They consisted in frequent desire to urinate, pain during urination and exceptionally an increase in the amount of urine. A moderate degree of albuminuria which was probably febrile, was not infrequently noted, but in no instance did the microscope show in such cases the presence of nephritis. Hæmaturia was never observed.

The appearances noted in the lung were much less marked than those reported during the first tuberculin period. The most common symptom was a more or less severe irritable cough, which was rarely so marked as to need treatment, and which usually disappeared with the end of the reaction itself. Less frequently there was an increase of the cough which had existed before the reaction. The appearance of sputum when the latter had not been emitted before, was only observed in isolated instances, and the same is true of an increase of an already existing expectoration or a qualitative change in the same. The latter consisted mostly in the fact that the expectoration became more fluid and more frothy and occasionally more compact and more purulent. Admixtures of blood were relatively rare, and bleeding from the lung in the proper sense was only observed in one case. Nosebleed was observed in one case. Not infrequently there were complaints about difficulty in breathing or of a feeling of depression in the chest, but a marked dyspnoea was not observed in any patient. Pains in the chest were frequently observed in the region of the pulmonary lesions.

The results of the objective examination were not very marked. In most cases there were slight changes in the physical signs, and only in one case a diffuse bronchitis extending over the entire lungs. These changes consisted in the appearance of râles, in the greater distinctness of previously-existing râles, the constant presence of râles which previously had been present only occasionally, or in the increase and enlarge-

ment of râles as well as in the appearance of a sharpened expiration instead of a normal breathing.

Only in one case did bacilli appear in the sputum which was previously free from these germs. On a whole, it may be said that a change in the physical signs and an appearance of symptoms which had not been present before was not a very frequent event, although these changes are valuable in the location of a focus. Yet, when they are absent, the absence of a pulmonary lesion cannot be positively asserted if the general reaction is present.

The acute febrile reaction is also accompanied by palpitation of the heart which sometimes occurs in typical paroxysms or at times in attacks which simulate those of angina pectoris. No objective signs were noted on the part of the heart, except an acceleration and a slight irregularity of the pulse. A dilatation could never be proved to exist, but it is possible that it occurs during the height of the reaction, during which the patient is not observed. In addition to these symptoms there occur also at times pains in the back, in the loins, in the eyes and the teeth and for several nights there may be profuse sweating independently of the rise of temperature, or the night-sweats which had been present before the reaction may disappear. After the reaction is over the patient feels very much better and often stronger than before, and all subjective symptoms disappear. It has happened that patients refused further treatment on the ground that they felt so well after the reaction.

A very disagreeable feature of these injections in many cases is that they cause intense pains at the site of the introduction of the needle. These pains are often so severe that the patients are not able to lie on the side of the injection. The pains may radiate to a distant region, sometimes involve the entire neck, the back of the head, the arms, etc., and may be accompanied by a feeling of formication, tingling and numbness. The size of the painful area varies in proportion to the dose and to the rapidity of the reaction. Abscesses were not observed in any case, but often there was a moderate swelling and quite a severe infiltration of the skin, combined with a marked redness over a large area. The swelling is hot and painful to the touch, and resembles erysipelas or erythema very closely. The glands in the neighborhood of the site of injection become moderately swollen and painful, an occurrence which should not be considered a tuberculous reaction. When the reaction was marked there was sometimes herpes of the face.

Of the patients in whom injections were used, two died. The first one came to the autopsy table and had not reacted. In the second case a moderate and transient reaction had occurred, but the patient died six weeks after the injection, so that the death could not be attributed to the tuberculin. In a third case death occurred in a peculiar manner. Three weeks after injection the patient got typhoid fever, which was followed with miliary tuberculosis of the lungs. No connection could be thought of between this attack and the injection.

In concluding, the author does not deny that there are certain dangers connected with tuberculin injections, but these may be avoided by a careful examination before the injection is given. He affirms that the diagnostic value of the injection is unquestionable and recommends the use of this method in dispensaries under observance of the precautions described. Further investigations are needed to show the nature of, and frequency of the dangers connected with this method, and should these prove to be considerable, the use of tuberculin should be stricken from the list of methods of diagnosis of consumption.

THE STRUGGLE AND THE IMMUNIZATION OF THE ORGANISM AGAINST TUBERCULOSIS.

Maragliano, in a report to the Fourteenth International Medical Congress in Madrid, presented one of the most important contributions to the discussion on the various means of immunizing the organism against tuberculosis. The following is a review of the German translation of the article which appeared in the *Berliner Klinische Wochenschrift*, June 22 and 29, 1903.

The author began by reminding us that he has devoted thirty years to the working out of the problem in question. In 1895 he, for the first time, asserted in Bordeaux that there is such a thing as a tubercle antitoxin and that it is possible that it may be employed in the treatment of human tuberculosis. Since then, after many and heated discussions, the existence of an antitoxin of tuberculosis has been admitted by all who have written on the subject. Many investigators, among them von Behring and Arloing, found that it was possible to isolate a tubercle antitoxin from animals, and many practical physicians have confirmed the possibility of using it in the treatment of human tuberculosis, as well as its efficiency in

cases in which the process is not too far advanced. The present article deals with another point regarding the struggle against tuberculosis, namely, the ways and means whereby the organism can defend itself and whereby it can create within itself an immunity against the disease. This question has occupied the author for many years, and in the present paper he gives the result of the studies which were undertaken towards its solution by himself and by his pupils. These studies were all made publicly in the Institute for Infectious Diseases directed by the author.

It is a well-known fact that, although the tubercle bacillus is very widely distributed in the cities, a very large number of persons and animals remain immune against this germ. Experiments have proved that there is no such thing as an absolute immunity, for every organism can be infected if the amount of virulent culture introduced into it be large enough. It must be admitted, however, that in spontaneous infection we never have the condition obtaining as when large numbers of tubercle bacilli are injected into the veins. It is known that in the production of an infection the number of bacilli and the way in which they enter into the organism are very important factors. Entrance through the blood is most apt to result in a rapid spread of the infection. The question then is: Why are some individuals specially immune against tubercle bacilli, while others are not immune or have lost this immunity?

The poisons of the tubercle bacillus are the causes of the changes in the tissues and fluids of the body which occur in tuberculosis. These poisons have a two-fold origin. Some of them are elaborated by the bacilli themselves during their life, while others are contained in the bodies of the germs. Those poisons which are contained in their bodies are specially significant, because the dead bacilli possess the property of producing the same changes in the tissues as do the living and active germs. These poisons can be isolated from the bodies of the dead germs by boiling for a long time in water, and they act as inflammatory and death-producing substances on the tissues with which they come in contact.

The most important of the investigations referred to are those of Badano, one of my assistants, who has proved that when these poisons are injected into the lungs of animals they produce broncho-pneumonia. In order that the organism may be able to defend itself successfully against tuberculosis, it is necessary that it should neutralize the tuberculous poisons, should impede the development of the bacilli, and should destroy the bacilli themselves. The neutralization of the tuberculous poisons is the

most important of these elements, in the author's opinion; for when that takes place, the tissues are saved from destruction. This can be proved by a very simple experiment. When a small amount of tuberculosis poison (1-10 c. c.) is injected into the thigh of a guinea pig, and at the same time a small amount of an active culture of the tubercle bacillus, it will be observed that the infection goes on more rapidly than in another guinea pig which has received the same amount of culture without the addition of the poison.

Another series of experiments was undertaken in order to determine whether the healthy organism possesses means of defense against these poisons. It was supposed at first that it was impossible to kill a healthy guinea pig with tuberculous poison, and, therefore, tuberculous guinea pigs were used as controls. This control was evidently false and could not lead to correct conclusions. Besides, the glycerine solution of tuberculin which was used was inconstant, and varied very much in activity, and even glycerine itself is poisonous. The author's studies resulted in the manufacture of a product which was very constant and which contained 100 toxic units per c. c., so that 1 c. c. of this substance, when injected subcutaneously, would kill a guinea pig weighing 100 grammes. From that time on accurate experiments became possible; for we could see whether the use of a definite amount of poison could be neutralized by the serum of men and healthy animals, and so we could determine the exact antitoxic properties of this serum. The author's experiments proved that the serum of strong and healthy men undoubtedly contained means of defense whereby a deadly dose could be neutralized in a guinea pig. Experiments were also performed with the serum of various healthy animals, and it was found that some of these possess antitoxic properties, while others do not. Human serum contains the greatest amount of antitoxic material. Some of these serums also had a hindering influence upon the development of the tubercle bacilli in cultures, especially those of man, of pigs, and of calves. The serum of guinea pigs did not have any preventive action upon cultures of the tubercle bacillus. Another property of the serum of healthy animals is to agglutinate cultures of the tubercle bacillus prepared according to the process of Arloing. The serums of horses, of asses, of goats, sheep, dogs, and rabbits have all more or less pronounced agglutinating powers, while that of the guinea pig possesses scarcely any. The presence of agglutination removes all doubt as to the occurrence of a natural defense of the organism against the infection, and

in this Koch agrees with the present author. This agglutinating power of the serum is also found in healthy men in whom there is no sign of tuberculosis.

In addition to these powers which the animal organism always possesses in order to defend itself against tuberculous infection, there are some new powers of defense which are acquired only in the presence of the bacilli and their poisons. This the author can assert as a result of a large series of experiments which he has performed for a number of years in various animals and in man, and which he has published from time to time since 1895. These additional means of defense are manifested by the generation of a large amount of antitoxic and agglutinating powers. If the natural antitoxic power of an animal against tuberculous poisons is determined by the methods adopted by the author, and if small amounts of the same poisons are subsequently injected with it, it will be found that after a time the antitoxic power will be considerably raised. This has been done in dogs, asses, horses, sheep, goats, cows and in man. The increase was noted even in the first month, and grew as time went on. The serum of horses, which at first contained only 100 to 200 antitoxic units per c. c., increased to 1000 or 2000, even up to 8000, antitoxic units. In a healthy man it was found that in a month of systematic injections the amount of antitoxin was doubled or tripled. The author announced for the first time in Bordeaux in 1895, and since then a number of investigators have confirmed him, the fact that it is possible to produce an antitoxin of tuberculosis.

The introduction of bacteria into the body is also followed by the development of bactericidal powers in the same. Thus, while the injection of the serum of watery tuberculin, which consists of a watery solution of the bodies of the bacilli, produced a bactericidal power in the organism, when the living bodies of the bacilli are injected after proper preparation into animals, such antibacterial materials are developed with especial rapidity. This may be shown in a variety of ways. The animals may be bled, and their serum tested to see how much bactericidal power it had acquired. In this manner it has been shown that the blood serum of animals, which had been injected with tuberculosis material, possesses a more or less destructive power upon the tubercle bacilli. This first series of experiments proves without doubt that this action upon the bacilli is caused by substances which are dissolved in the serum of the animals experimented upon. A second series of experiments showed that these serums dimin-

ished the infectiousness of tubercle bacilli when brought into contact with them. By this method it has been possible to prevent the development of tuberculosis in guinea pigs in spite of the fact that virulent bacilli had been injected, which had proved deadly in the controls. Another test was still more conclusive. A certain amount of virulent cultures mixed with prepared horses' serum was injected into the peritoneum of a guinea pig. After from 24 to 36 hours the peritoneum was opened and a small portion of the fluid contents containing the injected bacilli was removed. A portion of this fluid was injected into the peritoneum of a healthy guinea pig, and another portion was used for inoculating some nutrient medium. No tuberculosis developed in the guinea pig injected, and the culture remained sterile. An equal amount of bacilli without serum injected into the peritoneum gave positive results. Dry bacilli, and especially living bacilli, have the property of generating these bactericidal substances in the organisms into which they are introduced. With these bactericidal substances there are also formed agglutinating materials, and by the method described the serum of animals acquires a marked agglutinating power, thus showing that the bodies of these animals develop greater amounts of antitoxic bodies when dried or when living and active bacilli are injected into them. The agglutinating property of serum is greater when bacilli are injected, while the antitoxic properties are greater when poisons are injected. The agglutinating property of the serum is, therefore, parallel to the bactericidal power and not to the antitoxic. All this goes to prove that in the animal organism it is the poisons which develop antitoxins, while the bacilli cause the development of antagonists; in other words, the organism possesses a variety of strong defensive powers.

In another series of investigations the author has tried to show what happened to the living and active bacilli when they were injected under the skin in small amounts. By simply removing from time to time small portions of tissue fluids from under the skin, one can follow the changes in the appearance of the injected bacilli, and it may be seen then that they are gradually inclosed by leucocytes and undergo destruction. This process was most actively noted in the dog, for in this animal the bacilli are almost all destroyed within five days, while in the guinea pig they show no appreciable changes in this space of time. Bacilli which are directly injected in small doses into the lungs of healthy rabbits are also destroyed. All this shows that the animal organism possesses two means of

defense against tuberculosis. One of these is the power inherent in the healthy body which can protect it from tubercle bacilli and their poisons. The other consists in new powers which have generated only in the presence of the bacilli and their poisons. It is possible that the powers which are inherent in the healthy body have their origin in reactions which have developed in the course of an early tuberculous infection which had remained latent; or it is possible that we may have to deal with congenital powers.

The conclusion from all these experiments is, that in order to prevent the spread of tuberculosis, the method which is pointed out to us by nature consists in increasing, so far as possible, the powers of defense of the organism. All our efforts should, therefore, be directed towards this goal. The disease will not be exterminated by sanatoria. There is no doubt that the state sanatoria are doing a great deal of good for poor consumptives, and may help to cure the disease, but they cannot play a decisive rôle in the social campaign against tuberculosis. In this respect the author compares the sanatoria to the sanitary cordons or the quarantine by which the spread of epidemics was supposed to be arrested in times gone by. Science and experience have proved that the best measures against the spread of infection are good conditions of health among the people, and that by this means the favorable soil is taken away from the germs of disease. Tuberculosis will only then be vanquished, when it shall become possible to strengthen the organic soil and to assist it with specific powers which will render it immune against the disease. In other words, when it will be possible to vaccinate it.

To this end the author has specially directed his studies and now reports what he has been able to find in this field. The first problem was the question as to how far an animal can be immunized against tuberculous infection. This the author has done as early as 1895. Since then he has continued his investigations on the same line and has immunized a large number of animals, some of them for a period of five years. He possesses a rabbit into whose veins he can inject virulent cultures of human tubercle bacilli without any harm, while control rabbits die in from 20 to 30 days. Eight years after the author had announced that he could immunize animals against tuberculosis, Behring stated in Vienna that he had succeeded in doing the same.

This vaccination and this immunization may be obtained in various ways and with various materials, as, for example, with very active cul-

tures, with dead and dried or with living and virulent bacilli, or with an extract of living and active germs. This extract must be made freshly, without heat or chemical substances, so that it contains the entire immunizing power, without danger of infecting the animal with tuberculosis. In this manner one can obtain rapid immunization, and it is not necessary to inject the material into the veins. Suffice it to say that it is possible by various methods to immunize an animal against tuberculosis, even against numbers of tubercle bacilli such as never would enter the human body under any conditions.

Is it possible to immunize man in the same way? Two possible methods may be pursued,—that of passive and that of active immunization. Passive immunization is induced by introducing the defensive materials which have been generated in the body of an immunized animal. This has been done, for example, in tetanus and diphtheria, and the author applied the same method to tuberculosis. He injected animals with the serum of immunized animals, and observed that in their blood there was formed a strong antitoxic and agglutinating power, while its action was also markedly bactericidal. Such animals strongly resisted injections of virulent bacilli into their blood. Furthermore, living bacilli which were injected under the skin together with the serum of immunized animals were destroyed with special rapidity.

Immunizations were also performed in healthy men, but of course it was not possible to test their resistance against virulent cultures as in animals. In man other standards had to be adopted, i. e., the antitoxic and agglutinating powers were measured and were found greatly increased, showing that the injection of the serum of immunized animals produces in a high degree the development of specific defensive substances in man. A still better proof of this fact was obtained in tuberculous individuals who are very much like animals infected with tuberculosis. The serum of immunized animals was injected into consumptives with the result that the tuberculous process disappeared, while in their blood there were found protective substances which could be easily measured.

These patients were permanently cured and the serum in their cases induced a true immunization. We must assume that such individuals would be reinfected with tuberculosis if the essential nature of the soil upon which the tubercle bacilli grew in their bodies had not become changed through immunization. The author has on record cases of patients in which ten years elapsed without any recurrence.

Another method of passive immunization is that which employs the alimentary canal for the introduction of protective materials instead of injecting it. But this method has not been generally adopted. The author has found, however, that the serum of animals which were fed for a time with blood clots from immunized animals acquired a high degree of antitoxic and agglutinating powers.

Behring not long ago expressed the hope that children could be immunized by feeding with milk of cows that had been rendered immune against tuberculosis. The present author says that he has already been able to affirm that milk of immunized cows contains protective substances, although in small doses, and as the digestive tract is able to absorb antitoxins of tuberculosis, such a protection is possible in both children and adults. The conclusion of all this is that we are able to-day to state that it is possible to produce in man a passive immunization against tuberculosis either by injecting antitoxin or by feeding.

But the author's aim is higher; he wants to produce an active immunity in man; to vaccinate man against tuberculosis just as we vaccinate him against smallpox, and thus to induce in him an auto-immunization. Active immunity is certainly to be preferred to passive; for in the former the greater part of the work of immunization is done by the organism itself, and the result is, that more permanent protective substances are generated. This is confirmed by clinical observations; for if a man has a tuberculous focus which later on is completely cured, he remains in most cases immune against the disease from that time on. This proves that the body has immunized itself against tuberculosis when the focus has healed completely and permanently. This fact, together with the others which have been shown four years ago and have been confirmed by later investigations, namely, that animals may be made definitely and manifestly immune against tuberculosis, has been the starting point of the author's studies on vaccination against tuberculosis in man. In these experiments he excluded all methods which involved the introduction of any kind of living bacilli into the organism.

The injection of cultures into the veins, even if they are rendered weaker, can never be applied in the vaccination of man as Behring did recently in calves. It is an error to assume that active immunization can be obtained only by the injection of such living cultures as Behring asserts. The author believes that this can be secured by harmless methods, and

the first example of an active immunization in man was obtained by the injection of tuberculous poisons in the experiments cited above.

As early as 1891 the author said concerning the old tuberculin that its action depended upon the formation of protective substances in the blood, and all the studies that have been made on the subject since then have contributed towards proving this assertion. In a few consumptives in whom he was able to cure the disease by the injection of the serum of immunized animals, he continued to inject tuberculin and serum and later on tuberculin alone, and obtained very good results, for the cures were permanent.

He next tried to find whether it was possible to immunize man by inducing a tuberculous inflammation at a peripheral portion of the body.

The chief difficulty in doing this was to produce everything that could be produced with living bacilli, without using living germs; in other words, to produce a vaccine which would be free from the danger of tuberculous infection. After many experiments the author was able to prepare a vaccine which, if injected into the skin, is capable of producing a tuberculous inflammation which is entirely free from the danger of infection, but which induces the development of immunizing substances in the vaccinated animals. Of course, these vaccination experiments were first tried on animals, and the author is able to announce that animals vaccinated in this way developed antitoxic, agglutinating, and bactericidal materials, and that they became immunized against the disease, so that virulent cultures injected into their veins remained harmless, while they were fatal to the controls. Convinced of the harmlessness of this method, he used it in man without, of course, testing the vaccinated individuals by injecting cultures. The arm was selected as the place of vaccination, and a small local inflammatory focus with pus perfectly free from germs, developed at the site of the vaccination, accompanied by a slight rise of temperature for three days. In these persons the blood acquired a marked agglutinating power. A great deal of work is still to be done in this direction before it will be possible securely to immunize man against consumption, but the author closes with the prophecy that the day will come when this will be accomplished.

THE PATHOLOGY AND TREATMENT OF TUBERCULOSIS OF THE TESTICLE.

Dr. Max Jordon (*Beiträge zur Klinik der Tuberculose*, Volume 1, No. 3) contributes an important article to our knowledge of tuberculosis of the testes. Until very lately, the theories concerning tuberculous degeneration of the testes, and its relation to tuberculosis of the genito-urinary tract as a whole, were based upon the following principles:

1. Tuberculosis of the testis is, in the great majority of cases, a secondary condition which develops as the result of tuberculosis of one of the other organs of the tract.

2. Tuberculosis of one part of the tract is directly dependent upon tuberculous infection of another part of the genito-urinary system.

3. In bilateral tuberculosis of the testis, the infection of the second testicle takes place through transmission from the diseased gland through the vas deferens or through the intermediation of a prostatic focus. These principles were the basis of the methods employed in the treatment of tuberculosis of the testicle.

Kocher (R. Koenig, 1898, *Deutsche Zeitschr. f. Chirurgie*, Vol. 47) says that tuberculosis of the testis is most often descending, and that it arises most frequently from various hidden foci in the prostate, and but rarely from a tuberculous affection of the kidneys or bladder. In rare instances tuberculosis of the testis may also arise from some tuberculous focus elsewhere in the body, by metastasis through the blood, but it is possible also that the prostate may serve as an intermediate station for the infection. Primary tuberculosis* of the testicle as the only localization of the disease is very rare, and even that may possibly be the result of an old prostatic trouble which has never been noticed. Kocher believes that an ascending spread of the disease from the testicle to the other portions of the tract is comparatively rare.

Lanz (1900) considers primary tuberculosis of the testicle as very exceptional, and thinks that the affection is most frequently the result of tuberculosis of one or the other organs of the genital system, so that tuberculosis of both testicles is comparatively frequent. König emphasized the fact that in the majority of cases of tuberculosis of the testis, nodules were found in the prostate or indurations in the seminal vesicles, and also

*The term *primary tuberculosis* denotes the fact that the testis was the first to be affected among the genito-urinary organs by haematogenous infection.

that in patients who have been suffering for a long time with tuberculosis of the kidney, the infection gradually descends into the bladder, then on one side of the seminal tract into the testicle, and finally the fact must be noted that tuberculosis is always primary in the epididymis. Among French surgeons, Calot (1902) recently advocated the theory that tuberculosis of the testicle is always secondary to disease of the prostate or the seminal vesicles, and that, therefore, castration could have no permanent result.

But these views, which are now so commonly held by surgeons, have received a sudden blow during the last two years through the publication of statistics of recovery after castration, and through the results of experiments upon animals, published by Baumgarten. Bruns deserves credit for the collection of 111 cases of castration, some of which have been observed as long as 34 years after the operation. In 78 cases one testicle was removed, in 33 cases both testes. Of the unilateral castrations 46 per cent. were permanently cured, 12 per cent. died of tuberculosis of the genital tract which was present before the operation, 15 per cent. died of tuberculosis elsewhere, especially in the lungs; 26 per cent. were seized with tuberculosis of the second testicle later on, and in most of these a second castration was performed. In the double castrations an observation of from three to thirty years' duration showed permanent cures in 56 per cent., while 15 per cent. died of tuberculosis of the genital tract, and 25 per cent. died of tuberculosis of other organs. According to Haas, of Bruns' clinic, nine of 115 patients, that is, not quite eight per cent., had tuberculosis of the urinary organs, and, in most instances, of the bladder. Six of these nine patients died of tuberculosis of the genito-urinary tract, and the participation of the urinary organs, therefore, may be considered as a bad prognostic sign. In 26 per cent. of these cases tuberculosis of other organs was found, namely, in 15 cases as tuberculosis of the lungs; in 8 cases, of the bones; in 8 cases, of the glands; and in 4 cases, of the joints. The statistics of Bruns, therefore, prove that one-half of those castrated were permanently cured; in other words, castration was effective in persons who were suffering from tuberculosis of the genital tract alone. On the other hand, the operation was of no avail in almost all patients who were at the same time suffering from tuberculosis of the urinary organs, and in most of those (86 per cent.) who were at the same time affected with tuberculosis of other parts of the body. The operation should not be considered a factor in this

last class of cases. Bruns concluded from his results that tuberculosis of the testes "with the remaining organs of the genito-urinary system intact" is not at all rare, and that, therefore, the spread of the disease may go on in an ascending direction from the testicle. Similar results were obtained in Czerny's clinic, but the proportion of permanent cures was even still greater (72 per cent. of double castrations). In the material collected by Trzebicky's clinic from 1875 to 1900, there were 60.4 per cent. of permanent cures. The unexpectedly favorable results of castration, especially of double castration, are incompatible with the notion that tuberculosis of the testis is the result of a descending infection, and the fact that nodules are found in the prostate, as well as in the vesicles, is to be explained simply by the occurrence of a primary affection of the testicle, followed by metastases in the prostate and elsewhere. At any rate, the results of castration show that primary tuberculosis is by far more frequent than has been hitherto supposed. The results of conservative treatment have not been collected in great numbers, but they show a confirmation of the conclusion reached from a study of the above statistics. The cures obtained by Calot and others with local remedies testify to the primary nature of tuberculosis of the testicle. Microscopical studies made by Büngner upon seminal ducts speak in favor of an ascending spread of tuberculosis. He found in a series of sections that the vas deferens was tuberculous in its lower segment, that its central portion was free and that the disease diminished in intensity from below upwards.

The experimental studies of Baumgarten and Krämer (Baumgarten, Ueber experimentelle Urogenitaltuberkulose. 30. Chirurg. Kongress, 1901) showed the following results in over 100 rabbits: After the injection of tubercle bacilli into the eye, under the skin, or into the veins, the testicle almost always remained free, a fact analogous to that of the rarity of the affection of the testicle in miliary tuberculosis in man. Infection of the urinary tract did not lead to tuberculosis of the testicle, and it was never possible to obtain a tuberculosis of the vas deferens or of the testicle by injecting tubercle bacilli into the urethra or into the bladder. On the other hand, the injection of fresh bovine tubercle bacilli into the epididymis always was followed by tuberculosis of the organ. The tuberculous process in these instances often ascended from the epididymis to the prostate, but never from the prostate to the vas or to the other testicle. Baumgarten concluded, as the result of his investigation, that

tuberculosis always spreads in the genito-urinary apparatus of the rabbit in the direction of the stream or secretion (semen or urine), and never against this stream. The explanation of this behavior of tuberculous infection lies in the fact that the tubercle bacillus is non-motile. It can travel only along the stream of secretion or along the flow of blood or lymph. Inasmuch as the direction of the lymph-stream and of the flow of semen is the same in the vas, tuberculosis can spread in only one direction; namely, from the testicle to the prostate. After the injection of tubercle bacilli into the urethra there follows in many cases a tuberculosis of the neck of the bladder and of the prostate, but never, in spite of the existence of the disease for eighteen months, was there a spread of the process to the vas and the testicle.

Judging from Baumgarten's results there seem to be the following possibilities of tuberculosis of the genito-urinary tract in man:

1. Primary affection of the epididymis and spread of the disease to the testicle, and, on the other hand, also to the vas, the prostate, the vesicle, and eventually to the bladder. A direct affection of the other testis and of the kidneys is excluded.

2. Primary unilateral tuberculosis of the kidney; descending disease of the ureter, the bladder and the prostate. Ascending infection of the other kidney and descending infection of the testicle are excluded.

3. Primary tuberculosis of the prostate; infection of the bladder. Affection of the testicles and of the kidney excluded.

Therefore, if the kidney be affected in primary tuberculosis of the testicle, or if the testicle be affected in primary tuberculosis of the kidney, or the kidney or testicle be affected in primary tuberculosis of the prostate, we have to deal with a metastatic infection through the blood.

The objection of König, that experiments on animals can not be directly applied to man, may be founded on good grounds, but Baumgarten's results increase in importance when the permanent results of castration, which have been cited above, and the microscopical findings of Büngner are weighed in the balance. It remains to be seen whether the frequency of primary tuberculosis of the testicle, which these facts seem to indicate, will be evident in clinical work. Yet, it is still doubtful whether the results of Baumgarten's experiments apply to man, that is, whether a descending infection does not occur. Yet the proof that a descending infection occurs in man, an occurrence which has been assumed to be the rule, is by no means free from objections. When both tes-

ticles are affected at the same time, or in rapid succession, it is probable that we have to deal with a coördinated infection through the blood. The material at hand so far does not seem sufficient for a decision of these moot-points, but the recent progress in our knowledge of the subject has brought forth new questions, the answers for which necessitate extensive investigations. As regards the treatment of tuberculosis of the testicle, no routine method can be successful in all cases. Various factors must be considered in outlining the methods of treatment to be employed in each case. The age of the patient, the form of tuberculosis, the course of the disease, the presence or absence of localizations elsewhere, are all important considerations. The author does not go into details as to the indications in the various types of cases, but considers a chronic primary or isolated tuberculosis of the testicle as the type of case for his remarks on treatment. In advanced cases, when the testicle has begun to soften, and when the process has extended to the skin and to the cord, castration is unanimously recommended. On the other hand, a great deal of discussion has been going on as to the proper treatment of this condition in the early stages, when there are isolated nodules in the epididymis, or possibly localized abscesses in this organ. During a discussion on this subject before the Paris Society of Surgery in 1900, Berger was the only speaker who advocated castration in the earlier cases, as a safe method of cure. In pure genital tuberculosis Berger advocated the removal also of the vas or even of the affected vesicle. Most surgeons, however, commended conservative treatment and partial resections and spoke of their unfavorable results with radical operations. Double castration was rejected by all, including Berger. Various reasons were given for the rejection of castration by the French surgeons. Some said that the removal of the diseased testicle very often was followed by disease in the opposite gland, while others declared that the operation sometimes was followed by generalized tuberculosis. All these surgeons were intent upon saving the testicle itself at any price, removing if necessary a portion of the epididymis, etc., but leaving the gland itself, which not only forms semen, but also plays a distinct rôle in metabolism. The removal of the organ leads, not only to impotence, but also to marked psychical disturbances. Inasmuch as tuberculosis of the testicle is generally a secondary condition, radical operations are of no avail according to these observers. In the early stage of the disease, moreover, the testis itself is intact, and its removal is not justified.

In Germany, Bardenheuer advocated the resection of the epididymis as early as 1886, and very recently (1900) Albert protested energetically against the frequent employment of castration, characterizing this procedure as unnecessary in the very chronic cases and useless in the more severe types. Lanz declared against castration on the principle that primary tuberculosis of the testicle is rare, and that as a rule there is a focus in the prostate, bladder, or kidney. He tried resection of the epididymis, accompanied by diagnostic incision of the testicle, but concluded that inspection can not determine the presence of tuberculosis of the testicles with any degree of certainty. The majority of German surgeons have advocated castration until very recently, and have considered this operation as the most certain method of curing tuberculosis of the testicle. Bier alone declared himself as a pronounced opponent of double castration, and supported Schlange in advocating conservative treatment even in more severe cases. The most radical position was taken by Bruns, who recommended castration on principle, the earlier the better. König, Sr., expressed the opinion that in the dry, shrinking form, which often remains stationary for several decades, the surgeon may remain passive as regards the question of removal of the testicle. The same idea was expressed by Gussenbauer. Bramann contents himself in mild cases with incisions, and with the use of the cautery, or with the resection of the epididymis and the vas, but when the testicle itself is involved, he always prefers castration. Czerny and Kocher are advocates of the radical operation.

In criticizing the various positions taken by surgeons on this question, the author notes that the opponents of castration, especially the French surgeons, base their principles of treatment partly upon isolated observations, partly upon pure speculation, and none of them can show an extensive material observed for a number of years. The mental effect of a removal of both testes in adults has been greatly exaggerated, and several hundred cases observed for considerable periods after the operation showed no unfavorable mental after-effects, except in one patient whose case is reported by Czerny. But it is doubtful whether the mental disturbance in this case was directly referable to the castration. In these cases the remarkable fact has developed that a number of them did not show the expected impotence. Bruns also showed that after one testicle has been removed, the second is more rarely attacked by tuberculosis than if the disease is allowed to take its own course. It is true

that in castration a healthy testicle may be removed, as it is impossible to tell with certainty by inspection during the operation whether or not it is diseased. The conclusion to all these considerations is that castration is a safe and proper method of treatment in this condition. Even with the conservative methods, sterility results from the atrophy or destruction of the vas, so that the advantages of this method consist only in the preservation of the "moral effect" of the testicle and in the preservation of potency.

The new ideas which the recent investigations have given us as regards the nature of tuberculosis of the testis must have some influence upon our view of the proper treatment of this condition. If tuberculosis of the testicle is, as a rule, primary and localized, it is theoretically possible that a cure may be effected by a partial resection or by conservative treatment. Neither partial resection nor the complete removal of the diseased testicle can have any effect upon the spread of the disease to the opposite gland if we accept the theory of a coördinate blood-infection. As yet, we can not decide the question of treatment in tuberculosis of the testicle without certain reservations and doubts. The ultimate decision can be made only in a number of years from now, on the basis of a large statistical material. In the meanwhile, it is best to follow the middle course. In all cases of pure genital tuberculosis in which the conservation of the testicle does not play an important rôle; in old persons, in men who have numerous children, and in whom the cure of the disease is more important than the preservation of the sexual function, castration is the most trustworthy method. In younger patients, in whom the preservation of the testicle is very important, we are justified in attempting to avoid castration. In cases with a slow chronic course, in which the testicle tends to shrink, we may use general measures, apply a suspensory and prescribe inunctions of iodine ointment. When an isolated nodule becomes softened, incision and enucleation, followed by packing with iodoform gauze, are indicated. In extensive infiltrations with numerous abscesses of the entire epididymis, resection through healthy tissues, including the vas, is to be tried. If the process extends to the testicle itself, and if the boundary between the epididymis and the testicle can no longer be drawn, castration must be resorted to.

ON THE OCCURRENCE OF LARGE CONGLOMERATE TUBERCLES IN THE HEART MUSCLE.

Stephani (*Beiträge zur Klinik der Tuberkulose*, Vol. 1, No. 4, p. 387) studied the pathology of three cases of tuberculosis affecting the heart in which there were masses of tubercles of considerable size. With the increasing number of observations and with the improvement in our knowledge of tuberculous lesions it is now recognized that tuberculous pericarditis is quite frequently met with. The same may be said of tuberculous endocarditis and also of miliary tuberculosis of the heart muscle. The occurrence of large tuberculous nodules in the heart muscle, however, is so rare that there are less than fifty cases on record in literature. For this reason the author describes the cases which he has observed.

The first important articles on tuberculosis of the heart were those of Haberling in 1865 and of Schöffler in 1873, as well as the thorough work of Sängner in 1878. The last-named author tried to classify the lesions observed. Since 1878 there has been no systematic collection of the cases on record in German literature. Labbé, in 1899, divided the changes in the heart muscle produced by the tubercle bacillus into four forms.

1. Large cheesy tuberculous nodes.
2. Diffused tuberculous infiltration.
3. Miliary tuberculosis.
4. Fibrous form of tuberculous myocarditis.

Another French author, Barrié, who collected all the cases published in the year 1896, classified tuberculous affections of the heart in three divisions.

1. Large cheesy nodes.
2. Miliary tuberculosis.
3. Diffused tuberculosis infiltration of the muscle, combined with sclerosis and loss of color.

Finally, Fuchs in 1898, in his thesis, reviewed the entire literature of the subject (Thesis, Paris, 1898). These articles dealt with all the forms of tuberculous myocarditis, but the present author confines himself to the rarest type, that characterized by large conglomerations of tubercles in the muscles. He excludes miliary tuberculosis of the heart muscle, because this condition occurs shortly before death, rather as the expression of a general infection than as a local disease process.

In differentiating large tuberculous masses in the heart muscles from other lesions we must consider the possibility of syphilis, cancer and actinomycosis. Gummata of the heart muscle are not extremely rare, and for a long time all large softened nodes in the heart were considered as syphilitic. In addition to the presence of other tuberculous lesions at the autopsy, the gross diagnosis of these masses will be assisted by the presence of a sharp connective tissue margin and the rather grayish color of the softened syphilitic node. Softened cancer masses are more apt to be mistaken for cheesy tubercles, as the author found in a preparation in which the microscope proved the presence of cancer. But these softened masses are rather dry and crumbling in character. Actinomycosis has been observed in the heart muscle of man, and its lesions are very similar to those of tuberculosis. The attention of the observer must in such cases be directed to the small grains of actinomycosis. In doubtful cases a microscopical examination and the finding of tubercle bacilli are decisive.

The author described three preparations of heart muscle which he secured from Prof. Arnold of the Pathological Institute in Heidelberg. In all three there were large masses of tubercles glued together into a single node. In one case there was an additional diffuse tuberculous infiltration and there were miliary tubercles under the endocardium. In this case the author noted particularly the presence of masses of round cells in the tendinous fibres. It is a question whether or not these cases were instances of primary tuberculosis of the heart muscle, followed by the development of general tuberculosis. The distribution of the disease was so uniform, all the organs were so markedly affected, and there were so many bacilli found in all parts of the body, that it is probable that the body was flooded with infectious material directly from the blood of the heart. This supposition was supported by the fact that the endocardial covering was not entirely intact over the tuberculous nodes everywhere. One could see the endothelial cells and the connective tissue membrane of the endocardium partly loosened and detached. In addition, the greatest mass of bacilli was found directly under the endocardium. Besides miliary tuberculosis, the last case showed, on autopsy, a thick pleuritic adhesion on the left side with the cheesy nodules and small cavities containing creamy pus in the left upper lobe, as well as slight cloudy swelling of the bronchial lymph-nodes. The other pathological signs were not so marked that one could say whether one or the other focus was

older than the large tuberculous node in the heart muscle. It is well known that a tuberculous focus undergoes caseation sooner or later, according to the nature of the tissue surrounding it, and that the size of a node does not indicate its age. It must be left undecided, therefore, whether this case was a primary myocarditis or a secondary tuberculous affection of the heart.

It is a question, indeed, whether a primary tuberculosis of the heart can exist at all. There are only three cases in literature which could be considered with some degree of possibility as primary tuberculous myocarditis. They are those reported by Demme, Noël and Knopf. Yet it can not be denied that it is possible that a characteristic tuberculous focus may arise in the heart muscle before similar changes occur elsewhere in the body. For we see primary solitary tubercles in other portions of the body in which we are compelled to assume a far more distant and complicated route of transportation for the infection; for example, in tuberculous periostitis, or solitary tubercles in the brain, the eye, etc.

As regards the way in which infection can travel in a tuberculous myocarditis, three possibilities must be considered:

1. Direct extension of tuberculous foci to the pericardium and myocardium.
2. Infection through the blood.
3. Infection through the lymph.

Most authors believe that infection through the lymphatics is the most frequent mode of spreading of tuberculosis that affects the heart. The collection of cases which the author gives in this article also shows, however, that pericarditis and myocarditis of tuberculous origin are frequently associated. It is difficult, indeed, not always possible, to determine with certainty which of these two processes is the primary one.

The next question to be considered is whether such a marked affection of the muscle runs on without any symptoms or whether it only gives clinical signs when the process extends to other organs; in other words, whether a thorough clinical study of the case can give a clue as to the presence of the diseased heart muscles long before death.

The author gives in detail the history of one of his patients, a young man 18 years of age (case 3). This patient showed no hereditary history whatever and always had been perfectly well until the year 1899, when he had a catarrh of the lungs, which lasted eight days, and which disappeared without leaving any cough. The first symptoms appeared in

1901, in the form of a cough, and pain in the right side at night on going to bed, loss of appetite, etc. These symptoms gradually grew worse, and morning-sweats and palpitation of the heart appeared. At that time the patient showed, on examination, a pleurisy on the right side, but no lesions in the apices and no cyanosis. The apex-beat was found somewhat diffused, and increased in intensity, the heart-outline was normal; the heart sounds were clear; the second pulmonary sound somewhat increased; the heart's action vigorous, somewhat excited and frequent. On Feb. 20th, the right apex was suspected. On April 6th, the pulse was regular, but still frequent, the heart-outline was normal, the sounds clear. On May 25th, he began having severe headaches, and grew sleepy until he was almost in a state of stupor. The heart outlines were still normal, the heart's action vigorous and regular, the heart sounds loud and clear, without any accentuation of the second pulmonary tone. His general condition grew worse, but the heart's action remained good. Cyanosis set in only on the seventh day before death, which occurred on the 10th of June. The diagnosis was cerebro-spinal meningitis and miliary tuberculosis. The remarkable feature of this case was that the temperature, which never exceeded $38^{\circ}\text{C}.$, was entirely in disproportion to the frequent pulse. During the last week there was a diminution in the pulse rate down to 84, with temperature of 37° or $38^{\circ}\text{C}.$ A lowering of the pulse rate in proportion to the temperature is characteristic of meningitis, but in this case even this lowered pulse rate was high as compared to the ordinary cases of meningitis, which give from 60 to 50 beats. The author does not claim that this behavior of the pulse is characteristic for an affection of the heart muscle, but it is sufficient to make one suspect the presence of disease in the myocardium.

It is evident that in an absolutely circumscribed affection of the heart muscle the clinical symptoms must vary to a considerable extent. Thus, a tuberculous node which occludes any orifice of the heart or which compresses one of the larger vessels will naturally give other clinical symptoms than one which is situated in the septum or in the apex of the heart. Thus, the difference between the various clinical observations reported in literature is explained.

A number of authors give the details of the clinical picture of tuberculous affections of the heart. All these writers give very indefinite heart symptoms, such as dyspnoea, cyanosis, changes in the pulse, and in only one observation, that of Pollack, a small pulse of 70 beats is reported.

In that case the tuberculous node was situated in the septum between the auricles. In all other cases the pulse was remarkably increased in frequency, often irregular both in quantity as well as in quality. This was the case in the instance reported in detail in the present article. In most cases the physical examination of the heart was entirely negative. The concensus of opinion of the authors who have written upon the subject is that it is impossible to make a definite diagnosis of such heart lesions. The clinical symptoms are scarcely sufficient to enable us to surmise that a change in the heart muscle has possibly taken place. Even in cases in which there is tuberculosis in the body elsewhere, as manifested by clinical symptoms, we are not justified in concluding from the indefinite signs on the part of the heart that there is a tuberculous lesion of that organ. A tabulated summary of all the cases of tuberculous myocarditis is appended to the article, including 36 cases. From this table it appears that in eight cases the sex of the patient had not been noted. In 16 cases the patients were men, in 12 they were women. More than one-fourth of all the cases occurred in children under ten years of age. The ages between ten and twenty years were next in frequency. The ages between 40 and 50 were least frequently represented. In 8 cases no location was noted for the lesions, in 18 cases one of the cavities of the heart was affected, in 7 cases two of the cavities, in three cases three and in one case all the cavities of the heart were involved. The right heart was affected in 22 cases, the left in 12. In one case the septum between the auricles and in three cases the septum between the ventricles was involved. The septum between the auricles and ventricles was affected on the right side in three cases, and on the left side in one case. The right auricle was affected in 11 cases, the right ventricle in 8 cases; the left auricle in one case, the left ventricle in 11 cases. Tuberculous disease, therefore, affects for the most part the right heart.

As regards an affection of the pericardium coincident with that of the muscle, no statement is given as to this in 5 cases; in 7 the pericardium was distinctly free from disease, in 23 it was involved, as a rule in the form of a complete adhesive pericarditis. As regards the endocardium, no information is given in 16 cases, in 12 it was found free, and in 8 diseased. In one of these cases there was diffuse thickening and yellow discoloration, in 5 cases distinct ulcers, while in the remaining cases there were only small tubercles on the endocardium. As regards the affections of the other parts of the body there was great difference in the

various cases. In 15 instances there was a more or less pronounced miliary tuberculosis. In those cases in which the endocardium itself was found loosened or defective the disease of the heart muscle may be considered as the origin of the miliary tuberculosis. In two cases there were no tuberculous lesions to be found in any other part of the body. Of these, one case is reported in detail by Demme and the other is briefly mentioned by Noël. In the latter, the data are too inexact to warrant its classification as a case of primary tuberculous myocarditis.

AFFECTION OF THE CAUDA EQUINA AS THE RESULT OF TUBERCULOSIS OF THE SACRO-ILIAC SYMPHYSIS AND OF THE ADJOINING PELVIC BONES.

Bartels (*Mittel. a. d. Grenzgeb. d. Medizin u. Chirurgie*, Vol. 11, No. 3, p. 327) reports two cases of tuberculosis of the cauda equina which are remarkable on account of their rarity. Tuberculosis of the sacro-iliac symphysis and of the bones surrounding it was first studied at the beginning of the last century, but at that time the clinical features of the disease were but little known. Hahn, a German surgeon, was the first to present an exhaustive clinical study of this disease in the fifties of the past century, and it is only within recent years that operative treatment has been applied to these cases. In America, Sayre was the foremost student of the disease, and reported cures principally by orthopedic treatment, while in France, Ollier employed bloody operations. Within recent years Delbet rendered the diagnosis of this condition more precise, and Naz contributed the most complete monograph on the subject, in which he also mentioned nervous disturbances resulting from this affection.

German surgical literature is not abundantly supplied with treatises on this affection, and Wolff, who collected fifteen cases in 1899, could find only five cases previously published. Yet the frequency of the affection is not to be judged from the small number of published cases, and although the text books speak of the disease as of a very rare condition, the experience of surgeons who are specially on the lookout for this affection shows that this form of tuberculosis is not by any means rare. The clinical descriptions published show that this disease is often accompanied by disturbances on the part of the nervous system, especially in the nerve roots, both inside and outside of the spinal canal.

Although diseases of the cauda equina have frequently been the subjects of study of late, there is on record in literature only one case of tuberculosis of this part of the cord as the result of a caries of the pelvic bones, namely, that of Cestan and Barbonneix. It is very desirable, therefore, that cases in which the diagnosis has been made during life or at autopsy should be recorded, so as to furnish material for the more exact studies of the clinical features of this disease.

The first patient was a boy aged seven years, without any tuberculous family history. His father looked tuberculous, however, although the other children of the family were apparently healthy. In September 1901 the patient began to complain of pains in the legs, more markedly on the right than on the left side. He also was slightly lame at times, and occasionally he would have involuntary movements of the bowels. The pains increased and also occurred at night, until finally they became unbearable, and occurred in severe attacks, during which the child could neither stand, nor sit, nor lie, but had to be carried in the arms. The gait became worse and the right leg became stiff. On examination he was found emaciated, with swollen glands in the neck. In the region of the right sacro-iliac symphysis a swelling was noted, over which ran enlarged veins. This swelling was elastic and painful on lateral pressure at the sides of the pelvis. The arms were very thin, but did not show any disturbances of mobility. The legs were very much more emaciated, and the right leg especially was atrophied, particularly the buttock. The legs were usually flexed upon the knees, even in standing; the gait was waddling, very unsteady. The right foot hung down and was lifted higher than the left (stepping gait). The patient could not stand alone without being supported. On extending the leg there were severe pains in the knees, especially on the right side, but both hips were perfectly free from pain or stiffness. The right foot could be flexed dorsally only with difficulty, and could be slightly pronated and supinated, but was without any strength. Spreading of the toes was impossible. The patient complained of severe pains especially in the legs, which increased on extension. At times there was a slight pain in the swelling over the symphysis. Sensation was somewhat diminished in one area on the left side and above the anus where there was total loss of sensibility. On the right side of the anus there was an area of lowered sensibility in which the sense of temperature had disappeared, while the sense of touch had remained. The

knee-reflex was increased on the left side more than on the right, and the same was true of the other superficial reflexes.

The functions of the bladder were not disturbed, but fæces were often passed involuntarily. On rectal examination the promontory and the spot to the right of the symphysis were found very sensitive, and the latter seemed somewhat prominent. The symptoms described grew worse and worse in intensity, but remained the same in quality, although the area of anæsthesia on the right side of the anus disappeared. The hip could be flexed only when the knee was flexed. In the last part of the illness the hip was affected with tuberculous disease, and finally the lungs took part, and the patient died on September 10, 1902.

There is no doubt in this case as to the surgical diagnosis of tuberculosis of the sacro-iliac joint, followed by tuberculous infection of the hip and of the lungs. The spinal cord had remained intact. Some of the paralyses, such as those of the extensors of the foot, of the sphincter ani, and the disturbances in sensation, could be attributed to an affection of the sacral, pudendal and coccygeal plexuses. Against this stands the fact that these plexuses were found perfectly normal on pressure by rectum, and, besides, in such a symmetrical paralysis both plexuses would be equally affected. We must, therefore, conclude that the chief seat of the disease was in the spinal column, although it is possible that certain sacral nerves may have been compressed during their transit through the sacral openings. In favor of this are the pains in the right leg and the fact that in tuberculosis of the sacro-iliac joint the neighboring nerve trunks are almost always involved within the intervertebral openings. The question is whether the disease was in the spinal cord or in the cauda equina. But if we remember that the spinal cord ends between the first and second lumbar vertebræ and that the roots of the lower cord run for a considerable distance before they unite with the final ganglia, we must conclude that the cauda equina was affected. All the symptoms observed correspond with the compression of the cauda at the level of the first sacral vertebra. The middle fibres of the cauda were first affected and therefore a weakness of the rectum and sphincter ani were early symptoms.

The second patient was a boy aged twelve years, with a tuberculous family history. For the past two years he had complained of pains in the right leg, and was slightly lame. He had been treated for rheumatism. Three weeks before admission he passed his urine involuntarily, and during the last few days the genitals had become sore and swollen. On ex-

amination, the boy was small for his age, with enlarged glands in the neck, with an ulcer over the coccyx and intertrigo in both groins, as well as erosions on the prepuce, which was swollen. There was a lateral curvature of the spine to the right in the dorsal region, and a kyphosis to the left in the loins. The spine was not sensitive on pressure at any point and the patient was able to pick up objects from the floor without taking care of the spine. The joints of the hips, knees, and ankles were freely movable. The upper part of the right sacro-iliac joint was somewhat sensitive on pressure, but a swelling was not visible. Some pain was felt on pressure laterally upon the pelvis, but the examination by rectum did not show any painful points. The muscles of the buttocks and of the legs were markedly wasted, more so on the right than on the left. The legs were held flexed, but the feet were normal in position. The gait was waddling and painful. In the recumbent position the lower extremity when extended could be lifted to only thirty degrees without producing severe pains. When the knees were bent the thighs could be flexed and extended at will. There was total loss of sensation in an area around the anus, penis and scrotum and along a strip of skin on the back of the thigh down to the knee. A similar area was found on the outer side of both feet. The urine was found cloudy, foul-smelling, and full of pus.

Under appropriate treatment, the lesions of the skin improved and the urine cleared up. The pains in the legs were somewhat diminished by the use of various remedies, especially of pyramidon. The lower part of the spine became very much more sensitive to pressure, so that the patient could not lie even on a water-cushion. The boss and the curvature of the spine increased, the gait became more waddling, and the movements of the feet, especially on the right side, became weaker. The irritability of the muscles of the legs and of the sphincter were greatly diminished.

The diagnosis of compression of the cauda is not always easy, but we may often be led to suspect the presence of this condition if we think of its possible occurrence in tuberculosis of the pelvic bones. It is difficult to differentiate tuberculosis of these bones from other conditions. Disease of the hip should be carefully excluded by thorough examination. Contraction of the psoas, which also occurs in disease of the sacro-iliac joint, as well as in tuberculosis of the hip, may be puzzling. Most surgeons say that hip disease occurs only in youth, while sacro-iliac disease occurs in older persons, but both cases here reported were in children. In women,

affections of the internal genitals may simulate sacro-iliac disease. In one case, in a woman, sacro-iliac disease with abscess of the pelvic tissues was diagnosed as perityphlitis. Even in hysteria there is a condition which may give rise to severe pains in the legs at every movement and to pain on pressure over the sacro-iliac region.

In such cases attempts at walking or standing become impossible from pain, but on treating their hysteria and on exercising the muscles gradually the patients are cured. The distinction between tuberculosis and malignant tumor is difficult and is possible only after a close study of the case and its heredity. Syphilis may also be confounded with sacro-iliac disease, although it rarely occurs in this region. The disease that is most frequently confounded with this affection is sciatica; for the pains of tuberculosis of the sacro-iliac joint are very much like those of true sciatica. The nerve, however, is not at all sensitive along its course. It is well to look out for the possibility of sacro-iliac disease in all cases of sciatica, and it is often impossible to tell whether the nerve is compressed or whether the branches of the plexus within the sacral openings are affected. In sciatica the disease sets in as a rule very rapidly, and in spite of a great deal of pain, the zones of anæsthesia are not large and have not the characteristic locations. The knee reflex is usually abolished in sciatica and the bladder and rectum are not disturbed.

Of all the tuberculous affections of the bones sacro-iliac disease has the worst prognosis, and when compression of the cauda is added to this, the case is made still worse, and the prognosis is absolutely fatal. The patients are usually doomed to a very painful death. It is with great satisfaction, therefore, that we may greet any attempt at surgery to save these patients. The treatment may be expectant. By rest in bed, bandaging, extension of the limbs at night, etc., Sayre has obtained good results. Other surgeons recommend early operation. Bardenheuer had the best results with extensive resections. It is a question whether an operation should be undertaken, even in cases in which compression of the cauda has taken place. This depends upon the locality and the extent of the compressing structures. If the coccyx and the lower portion of the sacrum are already diseased, an operation will not be of any avail, at least the disturbances of the bladder and rectum could probably not be repaired. If, as in the second case, the presence of a compression is only suspected, and supposedly proceeds from the upper and posterior part of

the sacrum, an operation may be attempted, provided the lumbar cord is not affected.

We must determine, if possible, from what bony portion the disease has started, and whether it has attacked the sacral canal in front or behind, on the right or the left side, intradurally or extradurally. This is possible in cases of caudal disease in contrast to spinal, because the roots are separated anteriorly and posteriorly. The operative procedures used in spinal disease are not applicable to the cases of caudal compression. The local diagnosis of caudal compression can be controlled also by direct examination of the surrounding bones, externally as well as by rectum. For example, in the author's second case the history and examination showed that the compression was taking place at the posterior aspect of the sacrum. In this case the posterior portion of the sacrum was very sensitive on pressure, while on rectal examination the anterior aspect did not give any pain. In the first case, the opposite held good, but here the fifth lumbar vertebra had already become involved, and an operation would have been impossible. Conservative treatment was the only hope, but statistics show that the prognosis in such cases is absolutely bad, although some of the symptoms may be relieved. It can be determined, however, whether the process is progressing or not, and whether conservative or operative treatment is applicable, by a careful examination of the sensory and motor disturbances. Further observations are necessary, in order to determine exactly the indications for operative treatment.

QUARTERLY EPITOME OF CURRENT LITERATURE*.

I. ETIOLOGY AND PATHOLOGY.

A. PREDISPOSITION: 1. *Age and Sex.* MOOREHOUSE¹ studied the conditions under which tuberculosis developed in the city of Cleveland, Ohio, as regards the age and sex of the persons affected. The mortality of Cleveland from tuberculosis for seven years was 8.7 per cent. of the total number of deaths. Of the deaths from all causes, 1.4 per cent. occurred between the ages of 20 and 25 years; 1.6 per cent. of these deaths were in persons between 20 and 30 years. The total mortality from all causes was 130 per 100,000. Of all tuberculosis deaths 15.5 per cent. occurred

*January to April, 1903.

between the ages of 20 and 25 years, 30.3 per cent. between 20 and 30 years, and 50 per cent. between 23.3 and 44 years. As regards sex these deaths were distributed as follows: 4.9 per cent. of all deaths occurred in men with tuberculosis, and 56.6 per cent. of all dead persons were males. Of the total number of deaths 3.8 per cent. occurred in women with tuberculosis, while the total proportion of women among the dead from all causes was 43.4 per cent. The greatest number of deaths in males was between the ages of 25 and 29 years, while in females it was between 20 and 24 years. The greatest number of deaths from tuberculosis in proportion to the living population occurred between the ages of 55 and 64 years.

2. *Nature of Dwellings.* KAYSERLING² investigated the influence of the nature and surroundings of dwellings on the etiology of tuberculosis. He proves by statistics taken in Berlin tenements that the close contact between inmates in these dwellings favors infection with tuberculosis, and concludes that it is important to create proper facilities for removing these patients to hospitals or sanatoria, as well as necessary to improve the hygienic conditions of the dwellings of the poor. In 1901 2487 persons died of tuberculosis in their own homes. Of these, 1500 lived with one or more persons sleeping in the same room, so that at least 1500 persons in Berlin have been exposed to immediate contact with consumptives during the year.

B. SOURCES OF INFECTION: 1. *Family Infection.* OEHLER³ studied the sources of infection in 221 patients with tuberculosis. Of these he could trace the infection in only 25 instances. In 5 of these the mother was the source of the infection, in 10 the father, in 3 the grandfather or grandmother; in 3, strangers who lived in the house; in 3, husband or wife; in 1 a brother or sister. In children below the age of five years, it is far easier to determine the source of infection, as their lives are carefully watched, and they do not go to school. Of 37 patients of this class, however, only 12 showed a history of infection. It is dangerous to have children live with tuberculous adults, especially with those who have slow chronic cases of tuberculosis.

2. *Butter. Binot's Bacillus.* COURMONT and DESCOS⁴ caused tuberculous lesions by the inoculation of Binot's bacillus which is acid-proof and grows in butter. The animals experimented upon were dogs, and the germs were injected subcutaneously. Heretofore these bacilli were regarded as non-pathogenic when injected, unmixed with butter, subcuta-

neously. In these animals nodules developed in both lungs, but in no other organ. The serum of these dogs did not agglutinate cultures of the same bacillus. The lesions were typical, but no giant cells were found in them.

C. BACTERIOLOGY: 1. *Homogeneous Cultures*. HAWTHORN⁵ obtained a rich culture of tubercle bacilli within eight days, equal to one of 30 days' duration grown on ordinary media, by employing peptonized water (20 gm. of peptone Dufresne, 7 gm. of salt, and 1 litre of water, neutralized). This culture was perfectly homogeneous, without any shaking, but a precipitate formed on the sixth day, although never a pellicle. The bacilli were at first small, but from the sixth day on were of average size. An important fact was the lively motility of these germs, and their great vitality was remarkable. The reaction became alkaline, and no indol was produced even after four weeks.

2. *Solid Media for Tubercle Bacilli*. HAWTHORN⁶ found that tubercle bacilli, after having become acclimated on peptone solution, grew well on solid media, such as glycerinated potato (rapid growth, bacilli very motile); on glycerinated glucose-gelose, rapid growth, numerous colonies in 24 hours, irregular in shape, and almost transparent.

3. *Spore-like Bodies in Tubercle Bacilli*. HAWTHORN⁷ found that in homogeneous cultures grown as described above⁵, the bacilli showed spherical, very refractive bodies about one micron in diameter. They appeared at the end of the germ if the latter was moderate in size, and in the middle if it was very long. They were no more numerous in the older cultures, but were often found floating alone in the medium. They were more resistant to acids than the bacilli, and when they were decolorized they assumed a red tint in the centre, with a paler and thicker rose-colored border. The author believes that they may be spores on account of their resistance to acids.

4. *Chemiotaxis and Agglutination*. ARLOING⁸ reports that he found various tuberculous serums to be chemiotactic in proportion to their antitoxic powers. He found that chemiotaxis increases with the agglutinating power in homogeneous cultures.

D. PATHOLOGY: *Bacillaemia, Subacute Tuberculosis*. DEBOVE⁹ describes bacillæmia as a separate type of tuberculosis (bacillæmie tuberculeuse subaigue), although he does not indicate in what particular manner and by what channels or under what conditions tubercle bacilli penetrate into the blood, in order to produce this state. He defines it as ana-

logous to septicæmia, a subacute invasion of the circulation by the tubercle bacillus. The author reports a case in which subacute tuberculous bacillæmia was found at autopsy. The patient was a man aged thirty-four, who entered the hospital in a state of extreme cachexia, with rapid respiration, slight fever (38° C.) and semi-stupor. The liver and spleen were found enlarged and tender to the touch. No tubercle bacilli were found in the sputum, and no other signs of tuberculosis were discovered in the lungs, although there was a subacute bronchitis. The heart showed the distinct evidences of mitral regurgitation. There was persistent diarrhoea. The man died soon after admission, and at the autopsy a tuberculous endocarditis, affecting the mitral valve, was found. Tubercle bacilli were found in the blood of the heart. The spleen was found riddled with tubercles. The intestines were free from tuberculous lesions, and so were the lungs. The latter were, however, the seat of emphysema. No source of infection could be traced.

Whilst the case alone, without a more thorough study of the infection itself, does not count as material for any deductions as to the existence of a separate type of tuberculosis, which permeates the entire organism through the blood, the present case calls attention to the method recently devised by Jousset, called "inoscopy," whereby the presence of tubercle bacilli may be determined in the blood. This has always been a very difficult matter, owing to the fact that it was so hard to centrifuge blood. Jousset, however, devised a method whereby the tubercle bacilli are first liberated from the fibrin by liquifying the latter, and then the blood is centrifuged, thus precipitating the germs.

II. SYMPTOMATOLOGY AND DIAGNOSIS.

During the past quarter, a great deal of attention has been given by writers to the *diagnosis of latent tuberculosis*, especially to the question of joint-pains as forerunners of the disease. Two articles of interest have appeared in the French journals, that of BARBIER¹⁰ and that of HOBBS¹¹. Barbier devotes himself to the discussion of the *extra-pulmonary phenomena of latent tuberculosis*. He emphasizes the need of recognizing joint pains as possibly only symptoms of a latent tuberculous infection, especially in children. In a girl of fourteen years, whose case he analyses most minutely, the disease was ushered in by attacks of "tuberculous rheumatism." These were at times monarticular, chiefly in the ankles, at other

times polyarticular. Bone and muscle pain accompanies joint pain in some of these cases. The girl afterwards developed pulmonary tuberculosis. Hobbs insists very properly on the use of all the means at our command in the diagnosis of the latent stage of tuberculosis. He emphasizes the frequent occurrence of *joint pains* as early signs of the disease, and reminds us that it was Poncet of Lyon who first showed that pain and stiffness of the joints may be the only symptoms of an approaching tuberculosis. In such cases the examination of an artificially-produced blister as to the *leucocytes in its contents* offers a clue to the tuberculous nature of the joint pains. If tuberculosis be present in the patient, there will be a distinct diminution of the eosinophile cells in the serum of this blister, from 20 per cent. to 25 per cent., which is normal, to about 3 per cent. In the present case this test gave 2 per cent. of eosinophiles. The patient was a man aged 33 years, who had monarticular pain and stiffness in the right knee. He had rough breathing over the right apex, but no fever. Gonorrhoeal rheumatism was excluded by the history. Subsequently he developed pulmonary tuberculosis and died of this disease. The autopsy confirmed the diagnosis.

Cyodiagnosis also has been discussed a great deal of late in regard to its bearing upon the diagnosis of tuberculous affections of the brain and meninges. In an article by NOBECOURT and VOISIN¹² a case of tuberculosis of the cerebellum is reported, in a child in whom lumbar punctures were frequently made to obtain the cerebrospinal fluid for a series of examinations. These showed the presence of tubercle bacilli in this fluid, and, in addition, a moderate lymphocytosis. These signs spoke of a meningeal irritation. A marked lymphocytosis would have indicated a true tuberculous meningitis, and if the tubercles were all in the interior of the cerebellum, and none on the surface, the fluid would have given negative results. The autopsy confirmed this theory, as there was one tubercle on the surface of the cerebellum, beneath the meninges, while the organ was riddled with tubercles in its interior.

An article by HANS PETERSEN¹³ deals with *the early diagnosis of tuberculous affection of the bones and joints in children*. The author establishes the trilogy of fever, stiffness and pain, and believes that these signs are important in the order named, fever with a daily rise being by far the most significant symptom of osseous or articular tuberculosis.

Two articles on *tuberculous lesions in the mouth*, occurring in persons who had no tuberculous affections of the pharynx, tonsils, etc., have ap-

peared recently, and are of some interest on account of the rarity of these localizations. The first of these is the paper of THAON and LEROUX¹⁴, who report a case of *miliary tuberculosis of the tongue*, extending to the inner aspect of the cheek without any primary tuberculosis in the pharynx or larynx. The patient was a man aged forty-two years, with a tuberculous family history, who had first shown signs of pulmonary tuberculosis four years previously. On admission there was found dullness over both apices; no laryngitis; many bacilli in the sputum. For three months past he had suffered with irritation, burning, and pain in the tongue on eating spices, drinking hot fluid, etc. The swallowing became painful, and the salivation abundant, the tongue red, swollen, and covered on its dorsum with a number of scattered distinct whitish-yellow tubercles which were typical in all respects. Two small ulcers with irregular edges were also found, probably resulting from the breaking-down of some tubercles. A month later a group of tubercles appeared on the inner aspect of the cheek, near the labial commissure. It could be seen on everting the cheek and could be felt by the patient with the tip of his tongue. Applications of lactic acid to the ulcers and the use of hydrogen peroxide as a wash improved the local condition somewhat, but the patient left the hospital of his own accord before the case could be traced further.

The second article of this class is by CLAUDE and BLOCH¹⁵, and deals with a rare case of *tuberculosis of Steno's duct* in a woman aged forty-seven years, with chronic pulmonary tuberculosis, but without any affection of the pharynx, tonsils, larynx, etc. The localization of tuberculosis in the duct of the salivary gland is very rare. There was a small, hard, circumscribed, rounded tumor of the size of a nut in the cheek at the level of the second upper molar. On everting the cheek the patient experienced pain; and pus flowed from Steno's duct. Tubercle bacilli were present in this secretion, as inoculations of it into guinea-pigs proved positive. Afterward the tumor softened and was incised from the mouth, whereupon it partly healed, though it continued to secrete a thin fluid that was not saliva. The authors say in closing that the occurrence of this case proves their contention that the liver may become tuberculous through an ascending infection along the bile ducts.

In genito-urinary tuberculosis, we find in the recent literature an elaborate analysis of the *symptoms of primary renal tubercle* by ALFRED POUSSE¹⁶, the Bordeaux surgeon. The author calls attention to the

frequency of primary or hæmatogenous renal tuberculosis, which is of course much more difficult to diagnosticate at the outset than is ascending tuberculosis of the genital tract. While the article does not contain anything startlingly new, it sets forth the symptoms of primary renal tuberculosis in a very clear and systematic manner. These symptoms are: Lumbar pain, urinary spasm, polyuria, pollakiuria, retention, cystalgia, hæmaturia, and the presence of tubercle bacilli in the urine with a bladder free from tuberculous lesions. The absence of general symptoms in these cases is also a noteworthy feature.

The question as to the *relation of tuberculosis to the sexual function* has again come up of late. In a recent Parisian novel, "Les Embrasés," by M. Corday, the psychic peculiarities of the consumptive, especially as related to his sexual life, are minutely analyzed. The scene is laid in a sanitarium for wealthy phthisical patients and the sexual excesses that are indulged in are very vividly portrayed. On the other hand, in a similar sanitarium for poor people, discipline and morality hold sway. The sexual mania of the consumptive has once more been grossly exaggerated in this narrative, and ERNEST WEHLI¹⁷, taking the novel in question as his text, criticises it severely for setting sanitarium life in such light, and awakening a feeling of distrust among prospective patients. He also quotes from answers to a letter of inquiry sent out by a French journal, in which Bernheim, Grancher, etc., expressed themselves on this subject. The majority of these authorities hold that sexual irritability may be increased at the beginning, but is usually depressed at the end of the disease.

The Mental Symptoms of tuberculosis have also received some attention of late. Thus, BIENVENU¹⁸ reports three cases of acute tuberculosis with progressive fever and a fatal ending, in which melancholia was a prominent feature. The autopsies showed general miliary tuberculosis, but there were no lesions in the brain. The author explains the mental symptoms by assuming that they are the results of a cerebral toxæmia from the products of the tubercle bacillus. Melancholia, he says, is a sign of cerebral toxæmia, while mania in consumptives signifies the presence of tubercles in the brain. A hereditary predisposition to insanity causes the localization of the toxins or the infection, as the case may be, in the brain.

New methods of diagnosis have been looked for by a number of investigators, but few very striking aids to an early discovery of the disease have

been added to the list. The *serum reaction* of Arloing has been given attention by a number of writers; the most important articles on the subject, however, have been abstracted in extenso in other issues of this Journal. HAWTHORN¹⁹ succeeded in obtaining a very delicate serum reaction in dilutions of 1:100 after 40 minutes, by growing the bacilli in homogeneous cultures by his rapid method⁵. With the ordinary medium, glycerine bouillon, the dilution of 1:20 was the highest that would give a reaction with the serum of the same patient. The author obtained reactions with his cultures when they were only 24 to 36 hours old. His work, therefore, seems to have simplified the process of obtaining the so-called homogeneous cultures needed for the serum reaction of tuberculosis, but as the article does not give observations on an extensive series of cases, as do those of Arloing and others, the work of Hawthorn needs confirmation.

An article entitled *A new method of looking for tubercle bacilli in the sputum* naturally attracts attention; though in principle not absolutely new, yet, we believe, but little used in working with tubercle bacilli, the process of Couratte-Arnaude is worth citing: Ten c. c. of sputum are mixed with 100 c. c. of water, and 10 drops of sodium hydrate solution, the mixture is boiled, shaking constantly till fairly homogeneous. Take 20 c. c. of this mixture, add 4 drops of acetic ether, and 4 c. c. of ordinary ether, emulsifying well. A precipitate forms, which rises quickly. It should be redissolved in soda solution, well shaken, and after adding an excess of ether, allowed to rest. Almost all the bacilli in the sputum will be found in the ring separating the ether from the rest of the liquid. It is very easy to take some from this ring and to stain the bacilli with one of the usual methods. The bacillus does not lose its sustaining qualities by this proceeding.

A method of finding *tubercle bacilli in exudates* has been suggested by JOUSSAL²¹, who styles his process inoscopy (from *inos*-fibrin). It consists in coagulating the exudate, either artificially or by allowing it to stand, and of digesting the clot by means of a pepsin solution, centrifuging the resulting emulsion, and staining the sediment. The addition of fibrinogen is the quickest way to produce the clot. This method is said to be especially useful in the diagnosis of early or latent tuberculous pleurisy, or peritonitis.

III. PROGNOSIS.

Prognosis is not a subject that is given much attention in current literature, except incidentally. An article by the late Bismarck's former

physician, SCHWENNIGER²², however, is interesting, as it opposes in an emphatic manner the current views on the value of specific therapy, and on the curability of tuberculosis. The author has evidently a number of axes to grind, and takes intense pleasure in grinding them. His article is admirably written in the strong, terse, virile German for which he is noted. He begins by sarcastically referring to the tuberculosis movement and the tuberculosis question as a "fad," and predicting that syphilis will take its place in a few years in popular interest, and that the great fuss that is being made about tuberculosis will slowly vanish into oblivion. He dwells upon the mistakes and disappointments of the first tuberculin period, but admits the diagnostic value of tuberculin. In regard to a question of administrative methods that has recently arisen in Germany he declares that the public sanatorium has a right to do with the patient whatever the authorities please, and that the latter can inject tuberculin into every patient on admission, as a test, the patient having legally no redress. Finally, he emphasizes strongly the fact that tuberculosis can never be cured absolutely, and says that no matter what treatment be adopted it will do some good. We must be satisfied if the patient is able to resume his work, and this is as much of a cure as we can expect, with any treatment, so it is of no use to try "specifics" with the idea of restoring the patient to what is known as perfect health, which is, after all, a relative conception.

IV. PROPHYLAXIS.

The number of articles dealing with the prophylaxis of consumption, which have appeared during the quarter under review, is very large, but the great majority are but repetitions of the now well-known principles which have been laid down at the various tuberculosis Congresses held since 1899. In France there has been of late more activity than heretofore, and the French may almost rival the Germans in the thoroughness with which the tuberculosis propaganda is being carried on. A very typical article which deals with this question is that of ARMAINGAUD²³. This author studies the causes of the diminished tuberculosis mortality of Prussia, and finds that the state sanatoria of Germany have not decreased this mortality, for the greatest fall in the death rate from tuberculosis has been in the years 1887-1893, when the sanatoria did not exist. The cause of this decrease lies in better general prophylaxis and better sanitation and supervision. As regards matters of public hygiene and as regards methods of administration and legislation, France might well, he says, imitate Germany, but France ought not involve herself in enormous ex-

penditure by building public sanatoria everywhere until the state sanatoria of Germany have proved the value of such institutions.

Under the heading of prophylaxis we must class also a very striking article by HAMBURGER²⁴, who suggests that *abortion be performed in every laborer's wife who is known to be tuberculous* in order to prevent the spread of the disease to the offspring, and to protect the consumptive mother from the baneful influence which childbearing has upon her malady. Extended comment is needless. The author bases his conclusion on the fact that 75 per cent. of all persons in Prussia have incomes averaging less than 900 marks; in other words, 75 per cent. of the population can not by any possibility possess the means of treating tuberculosis as it should be treated. It is a "disaster for a tuberculous working-man's wife to become with child, and it is impossible to treat her for tuberculosis during her pregnancy. The chances of children born under such circumstances are very slim, indeed. Hence the best thing is to interrupt the pregnancy." This must be done (with due pomp) after consultation with another physician, and (with enough red tape) after officially noting in writing the history of the case, etc. The only question we think the author still has to solve is: Where will the Kaiser get his soldiers if this principle is adopted?

V. TREATMENT.

Nothing very remarkable has been suggested during the quarter under review as regards treatment, but there have been a number of papers that have more or less permanent value on account of the experience which they embody. *Local treatment* of tuberculous lesions in the lungs has not been given as much attention of late as formerly, but a valuable suggestion in this line was offered by THORPE²⁵, who advises the use of *intratracheal injections* without the laryngeal mirror. He employed solutions of izar and of guaiacol in a series of patients in the form of these injections, and saw good results from the use of this treatment in combination with the open-air cure in Wei Hai Wei, where the climate is very favorable. The injections were made by holding the syringe, previously charged, in the patient's mouth, and at a deep inspiration passing its tip quickly behind the tongue, and shooting out the contents. In this manner the injections penetrated into the trachea in almost every case. The author used a glycerine enema syringe with the tip bent at right angles.

As regards *surgical treatment* of tuberculous lesions in children an important suggestion is that of TUBBY²⁶, who says that it is wrong to

keep children with chronic tuberculous surgical affections in urban hospitals. The child should be received in a city hospital, its case studied, the initial treatment or the operation employed, and then the patient should be sent away to a country hospital for convalescence. For this purpose he suggests that the London hospitals should establish branches in the rural districts, or should establish relations with rural hospitals in proper surroundings, for the recovery of these children amidst the advantages of country life. The urban hospital can not treat such cases as well as a rural institution, and it would be a good idea to have, according to the author's plan, the rural practitioners in the neighborhood of the hospital assist in the treatment of these children by attaching themselves as attending staff to these branch institutions. The treatment of tuberculosis in all forms in cities today undoubtedly tends to extend beyond the limits of the city walls, and therefore Mr. Tubby's suggestion is timely.

In connection with the *home treatment of tuberculosis* it has always been a matter of regret to many that the patient can not be so well supervised and his mode of life so well regulated as in an institution, and also that his condition can not be noted so frequently and any threatening changes can not be so well averted. In order to obviate this difficulty, JOHN MJOEN²⁷ suggests that a printed note book be given to each patient for the purpose of having a record kept of each day's condition. The note book contains printed rules and regulations as to every point in hygiene and prophylaxis, and blanks for the diet, the examination of the chest, etc., and the history of the case. Besides, it contains a ruled series of pages for the daily entry of the temperature, measured three times daily, the amount of food taken, and other details as to the presence or absence of night-sweats, of haemorrhage, etc. A weight record is also appended. The entries are made by the physician, except the daily temperature record, which is made by the patient himself.

The *hygienic and dietetic treatment* has been discussed by a number of authors within the past quarter. As regards the hygienic management of the sanatorium patient, HERBERT²⁸ insists on a number of very rational measures. Thus, cleanliness in the whole life of the patient from the first day of admission is made an essential. Moustaches and beards must be shaved, the hair must be kept neatly trimmed, the hands washed before each meal, and all utensils and objects handled by the patient must be sterilized daily. On admission, his clothing and all his effects (that

will admit it) must be sterilized. Tight and excessively warm clothing must be prohibited, e. g., the wearing of tight garters and suspenders. Handkerchiefs should be kept in the same pocket always, and this should be lined with paper to be burned at night. The patients should walk erectly and keep their posture upright as much as possible. Nurses should not be allowed to shake the bed linen, nor to sweep the rooms dry, nor to handle soiled linen unless it is wet. Patients should never be allowed to enter the kitchen and the other household offices, nor to pet any domestic animals.

As to *diet*, the value of a regimen including a great deal of meat has been the subject of a study by GALBRAITH²⁹, who strongly recommends the use of a meat diet in tuberculosis, as the result of certain researches into the value of nitrogenous elements in infection. Meats produce an increase in the leucocytosis, and induce an absorptive lymphocytosis, and an eosinophilia (4 per cent. to 5 per cent.). Animal food furnishes the most nuclein, and throws the least strain upon the tissues. To increase resistance and favor leucocytosis, meats should therefore preponderate in the diet.

In the line of treatment which may be called, for want of a better term, *direct*, i. e., intended to modify the activity of the germ or to heal the process induced by it, *hetol* has again occupied a number of authors within the past three or four months. A modification in the method of applying this remedy, which was introduced by Landerer, was announced by KRONE³⁰, who gave hetol by mouth in the form of *hetol-sanguinol* instead of subcutaneously. The hetol is mixed with sanguinol and is given in the form of pills. The author refers to this method as very practical, and efficient, and especially adapted to office practice in the country, etc. He condemns the use of alcohol as a vehicle for cinnamic acid compounds, or for any other medicinal agent used in tuberculosis. The *use of alcohol* as a constant remedy in consumption is to be avoided, and only small doses should be given occasionally as stimulants. If used continuously, it produces depressing and toxic effects. The author obtained very satisfactory results with hetol-sanguinol pills in a number of patients. There was a gradual general improvement in the majority of cases. He therefore recommends the use of this remedy in incipient cases of tuberculosis.

To show how much opinions as to the value of hetol differ, two important articles that have appeared within the past quarter may be cited. The first of these is that of TOBIAS³¹, who is strongly opposed at Lou-

derer's claims. He says that the majority of the adherents of hetol are "foreigners and physicians in sanatoria," while the opponents are found among the physicians of the large cities. In Berlin, for instance, Max Wolff, Ewald, Lenz and Tobias (*Berl. klin. Wochenschr.*, 37, 1900) tested this remedy in a large number of cases and were very much disappointed in it. The literature of hetol up to 1901 has been collected by Cantrowitz (*Schmidt's Jahrbücher*, Vol. 271) and this review contains a list of eighty articles. Since then four additional papers have been published on the subject and are analyzed by Tobias in the present essay. Cantrowitz found Landerer's claims in the main supported by the majority of observers, but on studying the literature of the subject Tobias found that two-thirds of all the clinical reports were favorable and one-third unfavorable to hetol. The matter, therefore, hangs in the balance. COHN treats the subject very conservatively, and reports fourteen cases in which he employed hetol to the best of his ability. His cases were all seen in private practice and he used hetol exactly as Landerer advised. He criticizes two recent advocates of hetol, Katzenstein (*Münchener med. Wochenschr.*, 1902, No. 38) and Riegner (*ibid.*, 1902, No. 46), who claim "anatomical cures" in ambulant cases. Cohn's results were: Cured, none; improved, one; unchanged, 7; became worse, 5; died one. This is certainly not a very good showing, especially in private practice. The author emphatically states that in his opinion subjective improvement should not be given any weight whatever, and that the disappearance of râles or of rough breathing does not mean an anatomical cure.

Lignosulphite is warmly advocated in the form of inhalations by SIMON³³ of Berlin, in a recent article. He used it with benefit in the early stages, and its advantage is that it reaches the focus directly wherever air can get in. It removes the stagnant bronchial secretion, stimulates excretion and reduces all the symptoms of the disease. The main point made by this author is that in using this remedy it is not necessary to employ the troublesome dietetic and hygienic measures which are the basis of the modern treatment of the disease. It is not needful to increase the resistance of the body in this way, as lignosulphite does that sufficiently well. To secure perfect ventilation of the lungs, however, after the treatment is over, he advises lung-gymnastics of a special type.

In no field of therapeutics has there been so much haphazard searching for a specific as in tuberculosis. Of late a number of alleged specific remedies have been brought forward, all of which must be looked upon

with extreme scepticism for the present. LEFFORT and LOMBARD³⁴ have added to the list of drug-specifics a preparation which they style "*cytophiline*." They do not say what the exact composition of their remedy is, but they hint, by generalizing upon this subject at the beginning of the article, that they have been working with an antiseptic which has been deprived of its toxic properties by the substitution of one of its radicle groups by another. For a supposedly scientific article, this is certainly too vague. Injections of cytophiline were made in a series of guinea pigs that had been previously inoculated with tuberculosis, and experiments showed that these injections prolonged the life of the animals as compared to that of the controls.

Another writer, GUERDER³⁵, informs us that he has discovered the *specific antitoxin of tuberculosis* in the *active principle of codliver oil*, which can be extracted in some way that is not exactly stated, dissolved in a vehicle the nature of which the reader is not told, and injected subcutaneously or into the tissues or cavities in cases of local tuberculosis. This active principle of codliver oil immunizes against the bacillus of tuberculosis (?) in virtue of an unknown antitoxic substance which it contains. The injections are made into or as near as possible to the local disease, one or two grammes of the "antitoxin" being used every four or five days. A local inflammatory reaction lasting a few days occurs after these injections. No other unpleasant symptoms have been observed. The author claims to have obtained 75 per cent. of recoveries by absorption of local foci in all kinds of local tuberculosis.

Maragliano's Serum has been written about in a few more or less important articles, especially in Italian. A significant paper, because coming from a German, but dealing with the Italian savant's remedy, is that of HAGER³⁶ of Magdeburg, who reports four cases of early tuberculosis as cured by the use of this serum. He concludes with the brightest prognostication as to the future of this serum, and thinks it is of great benefit in incipient cases. Maragliano's own article has been abstracted in extenso in another part of this Journal.

Reports on the value of *tuberculin* continue to pour in, and as time goes on one meets more and more collections of favorable data in regard to the worth of this remedy in the specific treatment of the disease. Here and there, there still arise strenuous opponents, but in the main the reports slowly but surely are turning in favor of Koch's remedy, if properly used. In connection with the subject of dosage, which is perhaps

the most important point now under discussion, in this field, the article of NOURNEY³⁷ which appeared recently is interesting. This author uses minimal doses of tuberculin, and believes that just as much good and far less harm may be accomplished in this manner. He begins by assuming that one tenth of a milligramme is safe as a diagnostic dose, provided there is no primary involvement of the meninges of the brain. The smallest possible doses should be used, and are most effective.

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BOOK REVIEWS.

THE DIAGNOSIS AND MODERN TREATMENT OF PULMONARY CONSUMPTION, WITH SPECIAL REFERENCE TO THE EARLY COMMUNICATION AND THE RECOGNITION AND THE PERMANENT ARREST OF THE DISEASE. By Arthur Latham, M. A. M. D., Oxon, M. A. Contab. Author of the Prize Essay on the Erection of his Majesty's Sanatorium, etc., 800, pp. 215, New York: William Wood & Co. London: Baillere, Tindall and Cox, 1903.

This little volume contains a collection of papers on pulmonary tuberculosis written by Dr. Latham, who recently was awarded a prize for the most approved design for a modern sanatorium to be constructed under the auspices of King Edward VII.

The author aims to cover the purely practical side of his subject, and has done this in a very concise and intelligible manner. His language is plain and direct, and his treatment of the intricate themes with which he deals is so lucid as to appeal specially to the medical student and the general practitioner. He has managed to crowd a mass of practical information into the small space of some 200 pages of large print. There is not a page in the book that does not contain important data regarding the modern status of the tuberculosis question, and the papers, originally disconnected, have been so arranged as to constitute a continuous story that reads easily and pleasantly as well as profitably.

While we fully approve of the book itself, and think that it will be of great value to the practitioner, we cannot help calling attention to certain points relating to two of the debated questions of the day connected with tuberculosis, namely, the value of tuberculin and allied products, and the human-bovine tuberculosis controversy recently raised by Koch. On these questions the author, we are sorry to say, expresses his own views, and supports them by quotations from authorities friendly to his own opinion, to the neglect of the other side.

In speaking of the contraindications to the use of Koch's tuberculin (p. 25) he warns against its use for diagnosis in cases with advanced lesions and marked fever. He does not say that in such cases the employment of tuberculin for diagnostic purposes is useless, simply because the diagnosis can be made without it; he warns against its use as from a source of danger. The nature of the danger is not very clearly set forth, but the reader is left to guess that it is the reaction in the lungs following the injection of diagnostic doses that is to be feared. An extensive experience with Koch's old tuberculin has shown us that this danger is not a real one, and that the injection of one or more small doses will induce a reaction which is sufficient for diagnostic purposes, and is perfectly safe. Of this opinion are a number of authorities who have made extensive trials with tuberculin. The author admits, however, that "in the absence of definite signs of extensive disease, the absence of fever, and the employment of small doses, there is no danger whatever in the use of tuberculin as a diagnostic agent in the early stages of consumption" (p. 26). Coming to the actual diagnostic value of Koch's old tuberculin the author takes the view that in regard to its positive and negative value the tuberculin test stands even with the Widal reaction in typhoid fever (p. 28). We think that this statement does not fit the case. The Widal reaction appears late in the course of typhoid fever (i. e., late for an acute disease), usually in the second week, occasionally not until the third week, and is absent in about 2% of cases. On the other hand, the great value of the tuberculin test lies in its early appearance, before any definite physical signs develop, and only in isolated instances (Cornet, J. M. Anders) is it absent in tuberculosis.

In considering the value of tuberculin as a specific mode of treatment, Dr. Latham says, in summing up (p. 154), "We see, then, that if this treatment is restricted to *purely tuberculous* cases, in which the disease is *not far advanced*; that is to say, to *non-febrile cases* of pulmonary tuberculosis, the remedy *at least does no harm*. How far the good results obtained are due to the remedy, and how far to the hygienic and dietetic measures employed, is another question. It would appear that at least as good results are obtained by the open-air methods, without the use of tuberculin in similar cases, and that *this remedy can not be relied upon in the absence of suitable conditions of hygiene and diet*. It can not, therefore, be regarded as a specific. The remedy, however, may be a useful adjuvant in some cases, and it is probable that if a specific is found for tuberculosis, it will be closely related to Koch's tuberculin. The italics are ours.

Now, that tuberculin, as it is used at present by those who know how to use it, does no harm, is an accepted fact. A few pages in front of this statement quoted above, Dr. Latham, in a brief historical resume (p. 152) tells us "Koch's tuberculin was looked upon with fear and disappointment owing to Virchow's statements of the dangers attending its use." Those who know what was going on in Berlin in 1890 know that what Virchow said was this: "I have never seen so many cases with tubercles in so many parts of the body, and so many cases of perituberculous pneumonia as I have in our series of autopsies upon subjects treated with tuberculin." This was undoubtedly true, but the reason of it lay not in tuberculin, but simply and solely in the unwonted zeal with which everybody at the Berlin Institute looked for tubercles

in organs that had been scarcely glanced at in the usual routine of examination, and in the fact that Virchow had given strict orders to have every single case examined microscopically to see whether there were any vesicles surrounding the tubercles, that were filled with exudate. Such a microscopic perituberculous lesion was put down as a pneumonia. In order to secure the most thorough study of the cases in which Koch's lymph had been used, Virchow doubled or tripled his staff of assistants at that time, and it was this thoroughness that made it appear that tuberculin produced dangerous effects.

But to continue with Dr. Latham's statement, in which we purposely italicized the words to be discussed. A "non-febrile case of tuberculosis" does not—we think Dr. Latham will agree with us—very often get to a sanatorium or fall into the hands of a private physician, and in such a case any form of treatment will give good results provided it be combined with the proper hygiene and diet. So that his statement, apparently somewhat in favor of tuberculin, does not really give the remedy any credit whatever. As a matter of fact, the use of tuberculin has given good results in a greater proportion of the more advanced cases with fever, but without extensive destruction of lung tissue, than any other mode of treatment. We do not know how extensively Dr. Latham has worked with Koch's tuberculin or with similar products, but we are certain that a study of the literature of the past five or six years would convince him of its value in the febrile and complicated cases in which he so stoutly rejects its application.

The statement that "tuberculin can not be relied upon in the absence of suitable conditions of hygiene and diet and therefore can not be regarded as a specific" is deficient in logical balance, for there is no remedy for tuberculosis, nor will there ever be one, no matter how specific, that acts or will act in the absence of these conditions. A specific is a remedy which antagonizes the specific etiologic factor of a disease. It has been shown now sufficiently well, that tuberculin does this to such an extent as can be expected from the nature of the malady. That diet and hygiene are necessary at the same time to build up the weakened organism does not count as a blot on the escutcheon of any specific.

While we differ from Dr. Latham's views on this subject, we repeat that we welcome his little manual as a most useful and practical work on tuberculosis from the view-point of the general practitioner. The chapters dealing with sanatorium treatment, the open-air treatment, and the home treatment give full value to the various methods in vogue at present and are excellently presented, well conceived and abound with interesting and practical details.

The author has evidently put into his work an extensive personal experience and a thorough and conscientious study of the questions connected with his theme.

INTERNATIONAL MEDICAL ANNUAL. A Year-book of Treatment and Practitioner's Index, 1903, Twenty-first Year. New York: E. B. Treat & Co. 1903. Price \$3. The practitioner will find the new volume of the International Annual series a most useful manual of reference in questions of diagnosis and treatment as they are viewed in the latest literature. The articles are necessarily brief and do not attempt to treat the various subjects exhaustively, but in each instance enough is given to enable the practical man to apply new therapeutic or nosologic facts in his daily

work, and to give him a hint as to the current of progress of medicine during the past year. For a student, a worker in a special field, a writer, or an investigator, this manual would not have as much value, inasmuch as it does not pretend to cover the literature of the subjects treated, nor to give a critical and detailed consideration of moot questions. On the other hand, the book should be found not on the shelf, but on the desk of every man whose time is limited, whose opportunities for reading are few, and who would like to keep moderately well abreast of the times.

The article on phthisis is under the editorial charge of Dr. H. P. Loomis of New York, who gives a brief but sufficiently full review of the various advances in the treatment of tuberculosis during the past year. The article on sanatorium treatment is under the charge of Dr. T. N. Kelynack, with an appendix by Dr. H. P. Loomis. In both only general conclusions are dealt with, and the value of sanatoria for consumptives is strongly emphasized. These articles may be regarded as fairly representative of the current opinions on the subject of sanatoria and may therefore be commended to the general practitioner as summaries of a great deal of discussion and study which has been going on in this field during the year.

THE HENRY PHIPPS INSTITUTE.

The Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis has arranged for the coming fall and winter a series of lectures by well-known physicians on the various phases of tuberculosis. Some of these lectures will be more or less popular in character and all will be free to the public. The Auditorium of the Witherspoon Hall at Juniper and Walnut streets, Philadelphia, has been selected for the purpose, having a seating capacity of nearly twelve hundred people.

The first of these lectures will be given by E. L. Trudeau, of Saranac Lake, New York, during the last week of October, his subject being "The History of the Development of the Tuberculosis Work at Saranac Lake."

The following gentlemen have been invited to give the subsequent lectures: Dr. Pannwitz, of Germany, in November; Dr. William Osler, of Baltimore, in December; Dr. Calmette, Director of the Pasteur Institute, at Lille, France, in January; Dr. Herman M. Biggs, of New York, in February; and Dr. Maragliano, of Italy, in March. All of them have accepted with the exception of Dr. Calmette, who will come if it is pos-

sible for him to leave his work in connection with his institute and the International Congress of Tuberculosis to be held in Paris in 1904. Subjects and exact dates will be announced as soon as possible.

The Director and members of the staff of the Henry Phipps Institute extend a most cordial invitation to the profession in general to attend these lectures. It is greatly desired that this inaugural series of lectures will prove a success and be largely attended.

The following additions to the staff of the Henry Phipps Institute have been made: Dr. M. P. Ravenel has been appointed Assistant Medical Director and Chief of the Laboratory; Dr. E. A. Shumway has been appointed Ophthalmologist, and Dr. J. F. Wallis has been appointed Dermatologist.

Lawrence F. Flick.

